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Putting the brakes on aviation



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Delivering effect

Thales ramps up missile production

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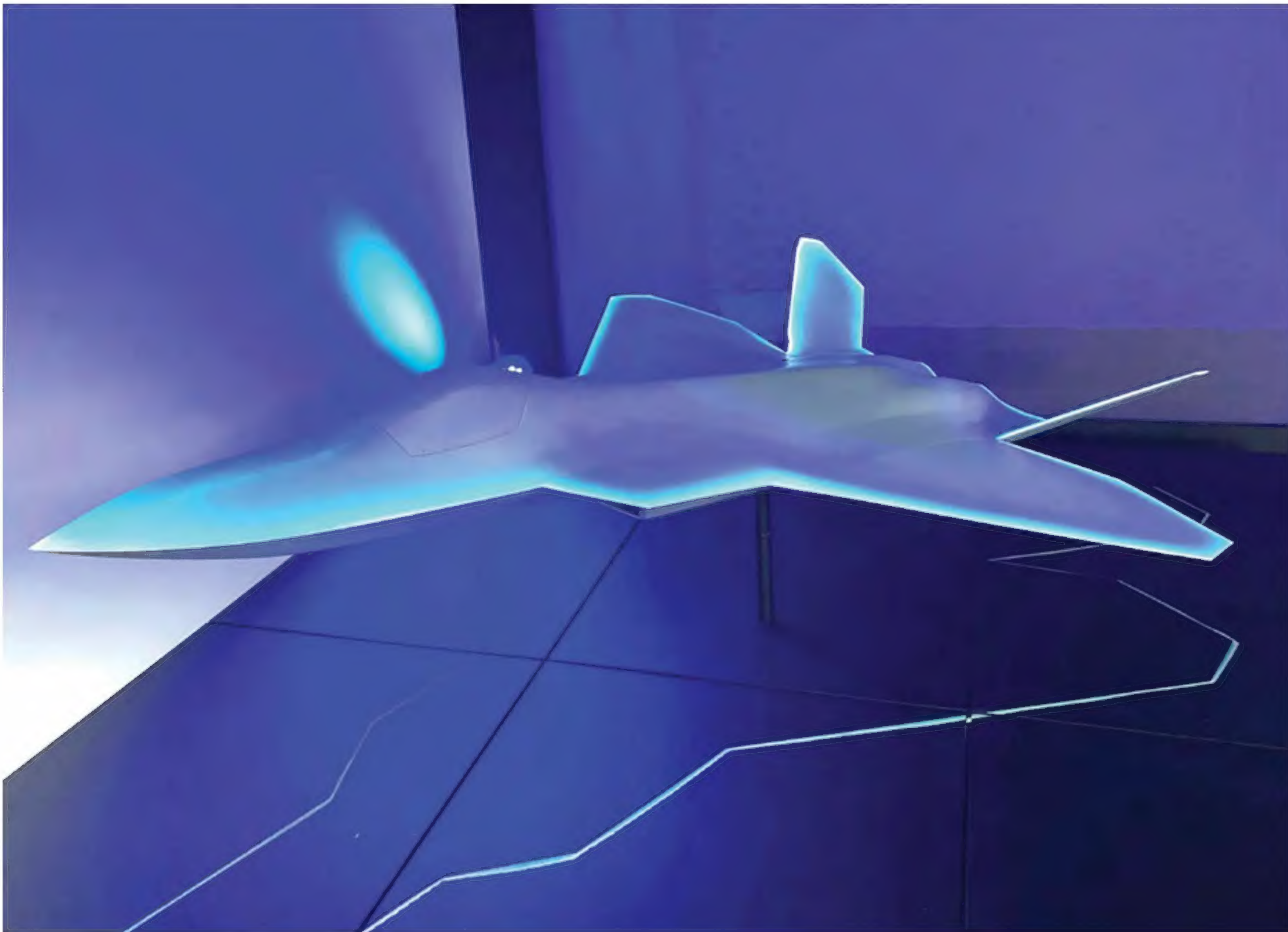


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Welcome

Is the UK at a crossroads in terms of defence? Along with many NATO nations, there's a shift in strategic thinking regarding the next threat, likely peer-on-peer engagement. Service leaders face the complex dilemma of financing between high-end technology capabilities that may be years off the front line or upgrading what they have in service already. Even though many military decision makers may now be working with increased defence budgets, the threat level has never been higher, and there's the need to show Russia, China and others a more 'capable and self-assured' West in more significant numbers. This is a critical point with the RAF;

there are not enough air assets to accomplish everything without compromising in another area. Other NATO air forces have the same dilemma, and operational pace and larger commitments, under the current circumstances, show no signs of slowing. Across the service, this is putting even greater strain on personnel, who are smaller in numbers but deployed far more often and for longer. While future technology, such as platforms like Loyal Wingman, may eventually shift the pilot to the edge of the engagement, where they can control the fight from a distance, this technology is still in development. For the present, manned platforms

and personnel are urgently needed in greater numbers. In the 1970s/80s, the Ministry of Defence issued repeated joint statements: "While the Warsaw Pact had significant numbers of aircraft, the West was technologically superior." Many things have changed since, but two issues stand out: Russia has significantly closed the technological gap, and the West is operating smaller military aircraft fleets. With NATO members approving increased defence budgets, it is crucial to use these resources wisely, balancing current numbers with future requirements.



Glenn Sands
Editor

TOP: Now with an increased budget, the UK Ministry of Defence has to decide how to invest in the RAF, with advanced programmes – such as Tempest – far into the next decade and beyond, or to upgrade and increase its current force in order to respond to and deter current threats
BAE Systems

FRONT COVER:
A Safran brake component for an Airbus A320
Adrien Daste/Safran



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Spending big for UK's security

UK Prime Minister Rishi Sunak has pledged that a Conservative government would increase defence spending to 2.5% of GDP, surpassing the 2% NATO target to which the UK has previously adhered. Sunak's commitment to put the UK's arms industry on "a war footing" comes in response to increased global threats, will entail spending £87bn per year by 2030, to ensure national security. This translates to the UK allocating a cumulative £75bn extra on core defence funding over the next six years.

Many nations across Europe believe that they are at a turning point in facing the threats imposed by Russia and that, by acting now, they will at least have the necessary assets in place and that these are technologically equal, if not better, than those they may face. Sunak has repeatedly stated that he'd waste no time in investing an estimated £10bn in munitions production to allow the UK to have deeper stockpiles of weapons. This is an issue that has significantly impacted

the Ukrainian forces fighting Russian units, with NATO simply unable to keep up with their requests for munitions of all types. Estimates for artillery rounds in Ukraine in February 2023 were 5,000 a day, equivalent to a small European's annual order in peacetime, according to a report in the *Financial Times* in February 2023.

In a recent speech in Warsaw with NATO Secretary General Jens Stoltenberg, Sunak underscored the UK's commitment to its allies: "In a world that is the most dangerous it has been since the end of the Cold War, we cannot be complacent. As our adversaries align, we must do more to defend our country, our interests and our values. Today is a turning point for European security and a landmark moment in the defence of the United Kingdom. It is a generational investment in British security and British prosperity, which makes us safer at home and stronger abroad."

However, for the RAF, the increase in the defence budget is potentially an opportunity to address issues that the service is currently struggling with, while

still fulfilling all its commitments in the UK and overseas.

A recent House of Commons Defence Committee report titled *Ready for War?*, published in January 2024, highlighted the level of commitment the UK armed forces had displayed. At the end of 2023, more than 7,000 UK personnel were deployed on more than 40 operations abroad. Some of these were long-standing commitments, while others were in response to unexpected threats or events. In the last quarter of 2023, the Secretary of State deployed a naval task group to the Mediterranean and both a P-8A Maritime Patrol Aircraft (MPA) and an RC-135W Rivet Joint to the Middle East following the Hamas attack on Israel on October 7 and the Israeli response. In addition to this, the RAF's commitment to units based at RAF Akrotiri means it is stretched to its limits. Some senior defence observers have questioned the service's ability to engage in peer-to-peer warfighting. However, this is offset by the knowledge that the RAF has good equipment in respect to its platforms and weapons, but doesn't have



MAIN IMAGE:

One of the newest F-35B, ZM168 (BK34), pictured at RAF Marham after its delivery flight from the US. RAF Marham took delivery of two new F-35B Lightnings on the evening of March 16, 2024

AS1 Butler RAF/MOD Crown Copyright

LEFT:

UK Prime Minister Rishi Sunak (left) is welcomed by Prime Minister of Poland Donald Tusk (centre) and NATO Secretary General Jens Stoltenberg (right) in Warsaw

Simon Walker/MOD Crown Copyright



enough of them, and that there is a pilot shortage. General Sir Nicholas Houghton, the UK's Chief of Defence Staff until July 2016, has stated that "the RAF was rarely asked to carry out a short-notice operation, other than QRA, on its own, meaning while it worked well in alliances on standing tasks, it would face difficulties in a warfighting situation."

There are suggestions that the increase in the defence budget should be used to address the shortfall in combat aircraft numbers. The retirement of 30 Tranche One Typhoons in 2025, many of which had plenty of airframe life remaining, should be reversed to retain 'combat mass'. Basing all these aircraft at one station, such as RAF Leeming, or reopening Leuchars would ease any support issues. If not, in 2025, the RAF will have just 107 Typhoons in service, although 48 F-35Bs should be delivered by the end of 2025. However, these will be jointly operated by the Royal Navy and will have a regular deployment to the two aircraft carriers in naval service.

Looking beyond the RAF's fighter

fleet, there are other shortfalls, perhaps most critical of which is in the number of fixed-wing transport aircraft due to the retirement of the C-130J Hercules. Plans to procure greater numbers of the A400 Atlas have already received a lukewarm response from the National Audit Office as being completely unaffordable. But that was before the recent announcement of an increase in spending, so whether this will now change remains to be seen.

The war in Ukraine has brought to the RAF's attention its lack of a dedicated SEAD/DEAD capability since the RAF retired the air-launched ALARM in 2013. The planned introduction of the SPEAR 3 missile with a multi-mode seeker will provide a new SEAD/DEAD capability when used with the F-35B's EW suite, but this is still some way off.

Across the wider RAF, the air assets are too few, with the number of P-8A Poseidons and E-7 Wedgetail AEW1s barely sufficient to cover operational commitments, although there is the possibility of buying back the two E-7 airframes that were cancelled, restoring

the fleet to the original five platforms. The decision to operate just a fleet of three Wedgetails was described as "an absolute folly" in a UK Defence Committee report. The increased defence budget should include a 'clean' Boeing 737 of the same type as a flight deck trainer and support aircraft, which would give the RAF an immediately available airframe if one of the E-7s were to be lost or damaged.

One fractionally less costly issue is the complete lack of air-to-air refuelling capabilities for the Poseidon MRA1, Wedgetail AEW1, RC-135W Rivet Joint and C-17 Globemaster, as they all lack inflight refuelling probes to make them compatible with the RAF Voyager tanker fleet.

Although the RAF has greatly benefitted from investment in the past 15 years, bringing into service new platforms and making the service more capable of meeting threats within the high-end fight, the increase in the defence budget promised by Sunak now needs to ensure that these platforms are present in more significant numbers and linked with the investment in spares, infrastructure and people. **AI**



Yes, Minister, GCAP is a vital programme for the UK!

The GCAP roadshow, a collaborative effort, arrived in London on April 24 and 25. The primary 'Team Tempest' partners – including BAE Systems, Leonardo UK, Rolls-Royce and MBDA UK, along with supply chain partners – hosted engaging drop-in sessions at the prestigious Royal United Services Institute, Whitehall. This was a unique opportunity for visitors to witness and contribute to the elements of the programme.

Organised long before the Prime Minister's announcement of an increase in UK defence spending, the partners were keen to highlight and explain the importance of the UK's sovereign combat air industry. Combat air is critical to the UK's defence, security,

prosperity and social value. Combat air generates a turnover of more than £6bn annually, provides 85% of the UK's defence exports and supports more than 48,000 highly-skilled jobs, including thousands of apprenticeships.

Developing next-generation capabilities will be critical to maintaining combat air readiness and ensuring that the sector continues to deliver strategic, economic and social value while protecting peace and security for the UK and its allies.

The event began on the day the USAF announced the down-select of Anduril and General Atomics for its Collaborative Combat Aircraft (CCA) programme, so it was perhaps appropriate that the first display visitors saw was BAE Systems' new Autonomous Collaborative Platform concept – a new design previously seen at the World Defense Show at Riyadh in February (see *Air International*, April 2024).

The aircraft is not part of the UK FCAS system of systems, and is a BAE company-funded project – representing what the company believes might be required rather than being designed to meet a specific, formal RAF requirement. It will doubtless draw on the company's experience with the Taranis UCAV technology demonstrator, the ASTRAEA Jetstream, and the Herti, Corax, Raven and Mantis UAVs.

Anthony 'Foxy' Gregory, BAE systems director for autonomous collaborative platforms, said the design was a "high-end attritable Tier 2" UAV, Hawk-sized with 'mid supersonic' performance. Estimated to be in the five-tonne class, the aircraft might be expected to have a fuel load of about 3,000lb, giving a similar radius of action to that of aircraft like the Saab Gripen.

The concept has two internal payload bays in the forward fuselage, capable of carrying weapons in the SPEAR III or SDB II size category, or a variety of sensor or electronic attack payloads, and potential for external hardpoints for the carriage of air-to-air missiles in more permissive scenarios.

The concept is low-observable by design and is intended to be attritable, not expendable. Life span will be driven by hitting a target cost point for an attritable use concept, but this class of vehicle is not intended to last long enough to require 'major' type servicing. Commentators have suggested that the US CCAs might be deliberately 'expended' at the end of their life. Still, Gregory suggested that it might be more cost-effective where possible to 'harvest' high-value systems and components (eg, sensors) for reuse.

JON LAKE **AI**

TOP LEFT:

BAE Systems' latest Autonomous Collaborative Platform is a Hawk-sized stealthy UCAV, built using digital engineering and additive manufacturing, ensuring it remains cheap enough to be attritable

Both images via Jon Lake

TOP RIGHT:

Former Tornado and Typhoon pilot Anthony 'Foxy' Gregory is BAE Systems' Director for Autonomous Collaborative Platforms, which promises to form a vital partner for the Typhoon, F-35 and future GCAP manned fighter

Rising

to meet demand



The announcement of a new helicopter leasing and finance company indicates that demand for supporting the offshore sector is returning. Oil production has significantly increased, partly due to the Ukraine war. This increase in demand has coincided with many operators seeking to replace older-generation helicopters and take advantage of the new technology and capabilities entering the commercial sector.

Keen to be part of this boom time is GD Helicopter Finance (GDHF), a start-up helicopter leasing and finance company based in Dublin, Republic of Ireland. Michael York, GDHF's founding chief

executive officer, spoke to *Air International* about his plans for the new company:

"The current dynamics of the helicopter market are favourable for lessors, operators and, to some extent, OEMs.

"The demand for helicopters is strong, while the available supply is tight now and in the future. This, coupled with the substantial increase in end-user rates paid to helicopter operators in the last two years, has created a healthy situation across the industry value chain. Thanks to our strategic planning and deep understanding of the industry, GD Helicopter Finance is well-positioned to capitalise on these market conditions.

"We [at GDHF] project continued momentum with the market robustly absorbing aircraft for various offshore

tendering activities across the globe and for other near-term end-user requirements," said York.

With the lessor market competitiveness increasing significantly post-pandemic, what will GDHF offer that's different? Quite a lot, according to York: "We'll offer customers near-term availability of the newest technology, efficient, cost-effective, multi-mission helicopters via OEM order books of 50 Airbus H160 medium helicopters and 20 H175 super medium helicopters along with our capacity to readily deploy additional capital to meet market requirements for helicopter finance.

"We aim to differentiate with a strong, long-term culture of customer focus, trust, integrity, speed and flexibility."

Two substantial orders have already been placed with Airbus, which will be delivered this year. York pointed out that the H225, AW139 and AW189 are other types being considered.

"We will be marketing helicopters for lease to customers in the energy, SAR, EMS and parapublic market segments worldwide," added York.

Asked where he regards the highest demand for offshore support, York said Brazil, Namibia and Guyana are the most active markets.

Given the highly experienced team, many of whom have years in the business, and industry experts behind the launch of GDHF, it's clear this new lessor has its feet on the ground in the road ahead... and its products in the air. **AI**



ABOVE: Michael York, chief executive officer of newly established GDHF, shakes hands with Bruno Even, CEO of Airbus Helicopters, at the signing of a contract for up to 20 H175 helicopters on April 25 GDHF

TOP: GDHF currently holds a large order book with Airbus Helicopters for delivery of 50 H160s, (illustrated) and 20 H175s, but is also in discussion with other OEMs Airbus Helicopters



Devin

The Royal Navy's Martlet anti-surface guided missile system (which uses the LMM missile as its effector) achieved initial operating capability at the end of October 2021
Royal Navy/Mod Crown Copyright

The momentous events of the last four years have provided NATO partners in Europe with a loud wake-up call regarding the limitations and fragilities of their national armament industries. Supply chain disruption resulting from the COVID-19 pandemic taught a lesson that maximum efficiency may translate to minimum resilience.



ending effect

The war in Ukraine has shown that production lead times are too long and stockpiles too small to meet forecast weapon consumption in any prolonged large-scale, high-intensity conflict.

This realisation, amid the backdrop of an increasingly hostile Russia and the broader geopolitical implications of the conflict in Ukraine, has compelled governments and industry alike to reappraise how complex weapons are

Thales is advocating a new partnering arrangement based on a sustainable 'always on' production model as it ramps up missile production at its Belfast site. **Richard Scott** reports

“At its heart, ‘Always on, always relevant’ is about embedding a new form of meaningful partnership between ourselves and our key customer.”

Alex Cresswell, chairman and CEO of Thales in the UK



procured and built. The UK government on April 23, acknowledged the need for a new approach, announcing an increase in defence spending and committing to make substantial multi-billion pound investment to grow weapons production capacity, re-create ‘surge’ capacity, replenish and grow stockpiles, and set a clear demand signal for industry through long term multi-year contracts.

The Integrated Airspace Protection Systems (IAS) business of Thales UK, which operates across two main sites in Northern Ireland, is living this change. As well as being responsible for the production of the Starstreak short-range, man-portable air-defence system (MANPADS) – originally developed to meet the British Army’s High-Velocity Missile (HVM) system requirement – and

the Lightweight Multirole Missile (LMM) precision-strike weapon used by both the Royal Artillery and the Royal Navy, the company also performs final assembly of Saab’s Next generation Light Anti-tank Weapon (NLAW) shoulder-launched anti-armour weapon. Substantial quantities of all three types have been supplied to Ukraine by the UK government as defence aid.

“One of the obvious lessons is that governments, as they shipped equipment to Ukraine, realised that there wasn’t very much in the cupboard, and then also realised that they hadn’t been buying stuff to refill the cupboards,” Alex Cresswell, chairman and CEO of Thales in the UK, told *Air International*. “And they also discovered you can’t switch the taps back on.”

Notwithstanding the challenges of restarting volume production activities, the company’s Belfast factory is ramping up again. “Missile output has doubled in two years to the highest level that we’ve ever produced,” Cresswell said, “and it will double again in the next two years.”

Heritage

Tracing its antecedents in guided weapons back to the early 1950s and what was then Short Brothers & Harland Ltd, the IAS business has its main factory in Castlereagh, east Belfast. Alongside a headquarters function, this facility serves as a centre of excellence for Thales’s air defence and surface strike solutions in the UK, and it hosts Thales Alenia Space’s propulsion competence centre.

“We have a long history, going back over 70 years, starting with Short Brothers, which later became Shorts Missile Systems,” said Philip McBride, managing director of Thales in Northern Ireland. The



business was sold to Bombardier in 1989 and then to Thomson-CSF, now Thales. We have a long heritage in designing, manufacturing, integrating, and supporting weapon systems.

"Today, we have just over 900 people in the Integrated Airspace Protection Systems business, with the majority [about 700] at our Belfast site."

Castlereagh serves as a leading engineering and manufacturing hub. On-site activities include the design and production of 'high-precision' missiles, associated fire control systems, and weapons integration onto tactical platforms.

According to McBride, the term 'high-precision' is deliberately used. "We're not discussing deploying a big weapon with a big warhead and hoping you get close enough to cause damage. Our missiles have relatively small warheads, so our effect on the target depends on our missile's accuracy."

Final missile assembly and test activity is performed in the more rural setting

of Crossgar, County Down, some 20km south of Belfast. "So, while we manufacture sections of the weapon system on the [Belfast] site, all our warheads and rocket motors are at Crossgar," said McBride. "We have a 40-hectare site with 40 process buildings, all doing different activities to bring a weapon together."

He continued: "Thales is one of only a handful of defence prime contractors here in Northern Ireland. There is a strong history of engineering and industry in this part of the world, but that has diminished somewhat in recent decades."

That situation is now changing as moves get underway to 're-industrialise' in the province. Alongside the Harland & Wolff shipyard – which will start building new support ships for the Royal Navy next year – IAS seeks to attract new blood into the defence industry. "Last year, we recruited over 140 people, and this year will bring another 100 into the business," said McBride. "This

CLOCKWISE FROM BELOW:

Rapid Ranger mobile integrated defence systems on the Belfast production line for a Middle East customer

Thales

The COREF facility at Belfast provides an industry innovation laboratory to mature and prove Industry 4.0 'smart' tools and processes, including collaborative robotics.

Thales



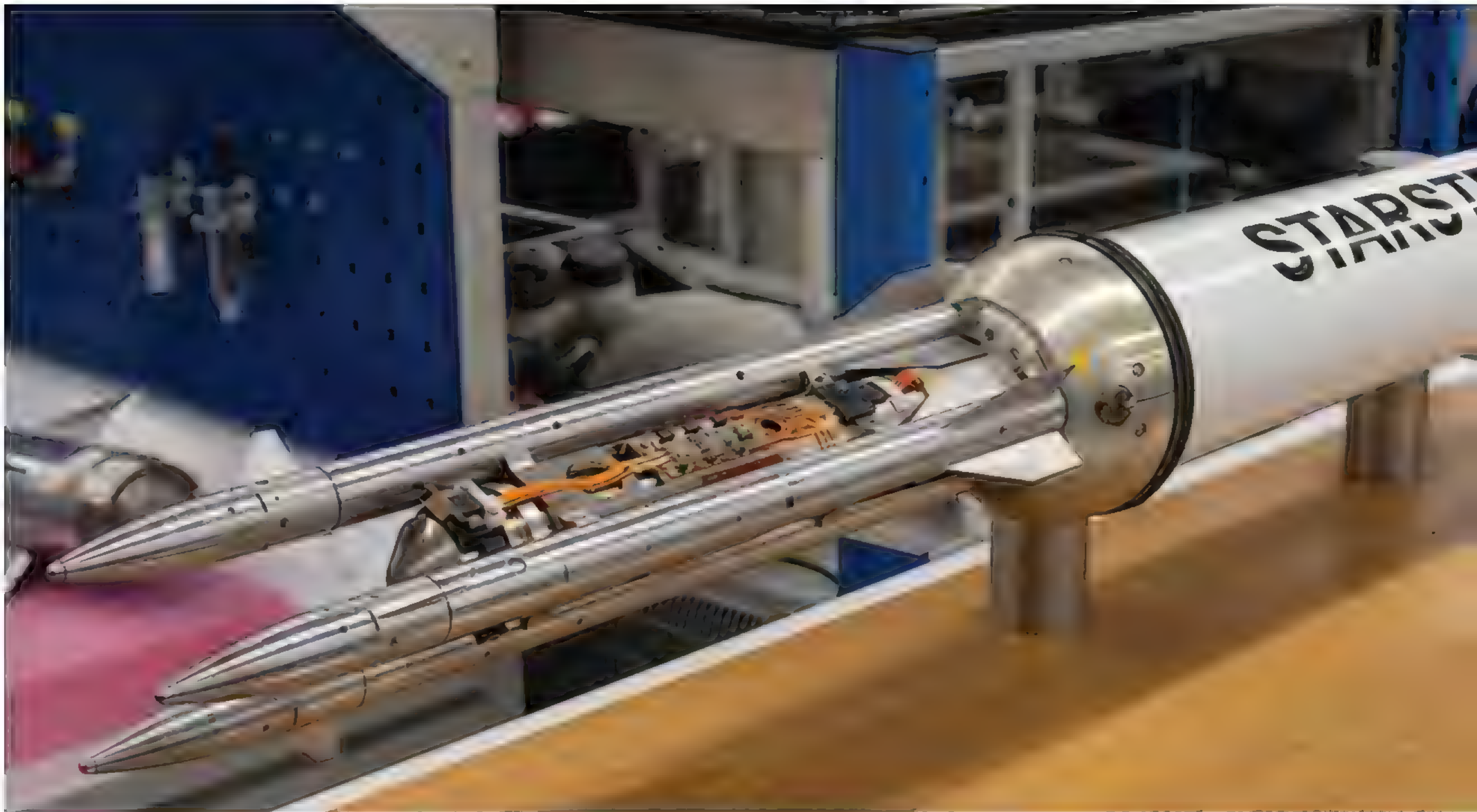
Lightweight Multirole Missile

Based on the aerodynamics of the Javelin S15/Starburst missile, LMM is a lightweight, low-cost, laser beam-riding missile designed for use from a range of tactical platforms to engage a broad range of conventional and asymmetric threats in the land, maritime and airborne domains. Fired from a sealed launch tube, the Mach 1.5 missile features a two-stage solid-fuel motor (offering a range out to

7km), a 3kg multi-effects warhead (blast fragmentation/shaped charge) and a multi-mode laser proximity fuze.

LMM has been designed for backwards compatibility with existing HVM launch equipment and can be fired from standalone shoulder-launch or lightweight multiple launchers or integrated onto vehicle-mounted systems such as Rapid Ranger. Helicopter-

launched and ship-launched exploitations of LMM have also been developed, with Royal Navy Wildcat HMA2 helicopters already deploying the former under the system name Martlet. Thales is working on spin-off projects – such as a semi-active laser-guided free-fall LMM and a Tactical Guided Sub Munition – that would re-use critical subsystems from the baseline LMM.



exciting, challenging and growing high-technology company with genuinely world-class engineering. We have a unique knowledge base and a highly skilled workforce – and we’ve had to grow very much ourselves.”

This commitment to nurturing engineering talent in Northern Ireland is evidenced by the close relationships forged with Queens University Belfast and Ulster University. The company has also opened a skills academy to foster and sustain critical skillsets.

McBride also points to the company’s apprentice scheme. “We see this as key to succession planning within the business and helping to promote a more diverse and inclusive workforce. We brought 30 new apprentices into our

business in September of last year. Again, that’s part of our plan to develop our own capability locally.”

He continued: “We add significantly to the local economy, around £80 million a year. This is one of the more deprived regions in the UK, so any contracts we receive offer a significant local benefit.

“We do have several local suppliers. So, where we can, we want to continue to use the local supply base and grow resident capabilities. So it’s not all about Thales but about that wider ecosystem we work in.”

Product portfolio

Shorts – the historic forebear of Thales IAS – established its reputation in the weapons sector by designing, developing

and manufacturing lightweight guided missiles and associated fire control systems primarily used for air defence. Having cut its teeth in the early 1960s with the Seacat naval point-defence system and its land-based stablemate Tigercat, the company developed the first-generation Blowpipe MANPADS. Blowpipe saw action in the 1982 Falklands conflict and also in the hands of Mujahideen fighters in Afghanistan. Still, its manually operated radio frequency (RF) command guidance system was found to be tricky to use.

The successor Javelin MANPADS introduced a much improved semi-automatic RF command to the line-of-sight guidance system. However, the subsequent adoption of laser beam

“Today, we have just over 900 people in the Integrated Airspace Protection Systems business, with the majority [about 700] at our Belfast site”

Philip McBride,
managing director of Thales in Northern Ireland





Starstreak

The Starstreak HVM is a short-range, high-velocity, short-range air defence system that provides battlefield air defence against various air threats, including fixed-wing fighter ground attack aircraft and 'late unmasking' attack helicopters. Unique in its class, the missile uses a carrier or 'bus' that releases three tungsten darts accelerated to a faster speed than Mach 3. Laser beam riding is used to ensure a very high level of accuracy and very high resistance to countermeasures.

Starstreak can be deployed in both shoulder-launched MANPADS and tripod-mounted LML configurations in the light role. A vehicle-mounted variant, known as Rapid Ranger, has been developed for light or armoured vehicles: Rapid Ranger is a modular, integrated launcher/fire control system combining two twin-round panniers and a stabilised sight head containing daylight TV and thermal cameras integrated with an automatic target tracker, a laser guidance unit, and an optional laser rangefinder.

riding guidance set Shorts apart from the competition. "The UK defence science community had by the mid-1980s come to a view that it was time to move away from RF control given concerns over the vulnerability of radio links to jamming," explained McBride. "Instead, we developed a form of laser guidance using a low-power beam for the missile to 'ride along'. This has the advantage that the laser link is virtually unjammable."

The first weapon from the Shorts stable to enter service using laser beam riding guidance was a modified Javelin missile given the designation S15. Replacing the original Javelin GL missile in British Army service from 1993, the S15 would later become better known by its export persona Starburst.

Next came Starstreak/HVM. Ordered in November 1986 to meet the British Army's Ground Staff Requirement 3979 for a short-time-of-flight close air defence guided weapon system, Starstreak was delivered in three distinct instantiations: a self-propelled system integrated into the Stormer tracked vehicle, a three-round Lightweight Multiple Launcher (LML); and a single-round shoulder-launched system.

Starstreak adopted an innovative 'little' approach using three independently guided tungsten darts to achieve a very high probability of killing. "The dart has to hit to do any damage, so it has to be extremely accurate and use very robust guidance," said McBride. "We're talking about hitting a moving object, the size of a basketball, at about five kilometres."

"The darts fly a helix cycle around the laser guidance beam. You only need one

to hit to defeat the target."

The development of Starstreak proved more challenging than initially anticipated, delaying the introduction to service until September 1997. However, McBride observed that the HVM design fundamentals have stood the test of time. "We still claim that it is the best air defence system in its class, anywhere in the world. There is no effective countermeasure out there."

LMM represents a departure in that, rather than being a dedicated air defence missile; it was purposely developed as a multi-role/multi-target laser beam riding missile with application in the land, air and maritime domains. "Again, it has to be accurate to hit small air targets like UAVs or strike at fast craft moving around on

CLOCKWISE FROM TOP LEFT:
The Starstreak HVM uses three independently-guided tungsten darts

Thales

The Thales site in Castlereagh, east Belfast, serves as the main engineering and manufacturing hub for the IAS business

Thales



the sea surface,” McBride said. “It has a multi-mode fuze so that it can function in either impact or proximity modes. And it has a relatively small dual-effect payload [combining a shaped charge with a pre-fragmented blast warhead], which limits collateral damage but again demands a very high level of accuracy on the target.”

Thales IAS also performs the final assembly for Saab’s NLAW anti-armour missile. “Belfast has been doing this since 2008,” McBride said. “This facility in

weapon system consumption rates that warfighting requires. Long wavelength ‘start/stop’ procurement cycles also make it more difficult to innovate and invest in emerging technologies, which impacts the business’s ability to compete for skilled labour in a highly competitive market.

Instead, Cresswell advocates for a new and more resilient ‘Always on, always relevant’ contracting model. “At its heart, ‘Always on, always relevant’ is about embedding a new form of meaningful



Northern Ireland is ideally suited for this purpose because of our specialisation in designing and manufacturing lightweight precision weapons.”

Always on, always relevant

As chairman and CEO of Thales UK, Cresswell maintains close engagement with the higher echelons of the UK Ministry of Defence (MOD). In recent months, he has been vocal in expressing concerns that existing manufacturing processes and supply chains have been shaped by peacetime ‘efficiency’ and are not equipped to respond to meet the increased platform and complex

partnership between ourselves and our key customer,” he explained. “If you buy 1,000 today, have those delivered in relatively short order, and then come back in ten years for another 1,000, then you may find that your source of supply is gone, and significant parts of the weapon must be re-qualified because of component obsolescence.

“The alternative is to buy 100 per year, and for every production batch, we will remove obsolescent components and limit re-qualifications to the minor changes made. That is a more sensible proposition from the prime contract point of view, but also more resilient the supply chain perspective.”



Martlet gives Wildcat sharper claws

The Royal Navy has introduced LMM as the effector for the Martlet anti-surface guided weapon, equipping the Wildcat HMA2 maritime helicopter. To meet the Future Anti-Surface Guided Weapon (Light) requirement, Martlet was conceived to deliver precise and proportionate effects against target sets such as fast inshore attack craft, jet skis and waterborne improvised explosive devices.

A Wildcat can carry up to 20 LMM rounds in five-cell launchers carried under a 'winged' stores carrier. The Wildcat's observer targets the missile: an active laser generation unit fitted inside the nose-mounted L-3Harris Wescam MX-15Di electro-optical/infrared/laser turret transmits a coded low-power beam along which the LMM 'rides' to its target.

Martlet achieved initial operating capability at the end of October 2021 following firings undertaken by a Wildcat

of 815 Naval Air Squadron embarked in the Type 45 destroyer HMS Defender as part of the CSG21 deployment. Work is expanding the weapon operating envelope before declaring full operating capability in 2025.

In July 2023, the Royal Navy – working with QinetiQ, the Maritime Warfare Centre, and Thales – undertook Trial 'Triton's Arrow III' on the MoD Aberporth range. The Wildcat Maritime Force fired 12 LMM rounds, split evenly between telemetry missiles (to confirm the performance envelope and validate performance modelling) and warhead rounds (to demonstrate the full end-to-end capability).

The trials, conducted over two weeks, involved firings against a range of surface target sets. Triton's Arrow III also saw its first air-to-air firing, which downed a Banshee target drone and proved Martlet's capability to operate in a 'hard-kill' counter-UAV role.

The ability to 'surge' is also part of the conversation with the MoD. Three key factors play in from the Thales viewpoint:

- **Greater clarity regarding long-term demand out to the ten-year mark to provide confidence in forward buys to accommodate the surge.**
- **The importance of export business.**
- **The relationship with the supply chain.**

"We would argue, and we have argued, that only our export business has given us any resilience and, therefore, the ability to deliver things in a much shorter timeframe post-Ukraine," Cresswell said. "In some cases, the [UK customer] had not made

purchases for more than a decade.

"And we were able to deliver some more HVMs to the MoD recently because, in 2013, we made a really massive stock buy in the supply chain. So, we still had [components] available to build from the cupboard."

"We also need to ensure that our demand signal to the supply chain is equally clear."

McBride added: "It's one thing to deliver battle-winning capability. But to do that, you need to have a resilient supply chain.

"So, a long-term relationship with key suppliers is necessary to ensure that in three years, five years, or ten years, you can deliver those capabilities when

CLOCKWISE FROM ABOVE:

A Martlet-configured Wildcat HMA2 helicopter seen operating from HMS Diamond with an outload of 10 LMM missiles

Royal Navy/MoD Crown Copyright

Another angle of the Starstreak tungsten dart

Thales

The NLAW production line in Belfast has been completely redesigned and redeveloped to meet the demands of a new production contract – covering several thousand rounds – awarded to Saab in December 2022

Thales

Next-generation Light Anti-tank Weapon

Saab developed NLAW as a short-range, single-use anti-tank weapon system suitable for dismounted troops operating in all environments and terrain. A single soldier can deploy the system in around five seconds and deliver a lethal charge against armoured vehicles at ranges between 20m and 800m.

Unlike many anti-tank weapons, NLAW does not rely on an active target-seeking system or a 'lock-on' signature. Instead, it uses predicted line-of-sight targeting, incorporating magnetic and optical sensors to reach the target location. Alongside Overfly Top Attack against armoured targets, the operator can select a Direct Attack mode for 'soft' targets and troops inside buildings.



your customer needs them.

"It's also important to have sustainable industrial capability. Over the last two years, we've ramped up and doubled our output, and in the next few years, we will double again.

"In the first instance, we've worked with Saab to ramp up and double NLAW's output. Now, we are in the process of doing exactly the same with LMM and, after that, Starstreak."

To do this, the NLAW production line in Belfast has been completely redesigned and redeveloped to meet the demands of a new £229 million production contract—covering several thousand rounds—awarded to Saab in December 2022. This has meant interrogating every part of the production process to identify non-value-added time and areas where new technologies and techniques could create a more seamless and efficient production flow.

A so-called Connected Reconfigurable Factory (COREF) facility on the Belfast site supports the ramp-up, particularly the roll-out of the automated production techniques

embedded on the NLAW line. Part-funded by the UK government, COREF is an innovation laboratory established to mature Industry 4.0 'smart' tools and processes – including advanced robotics – to improve the efficiency of electronic systems design and assembly processes.

The new NLAW production line is now up and running, and the same principle of 'flow' will be applied in the longer term to both the LMM and Starstreak production lines. However, while the LMM line is up to full rate in 2025, Starstreak will take longer, given the need to qualify multiple new components.

"The design won't change," said Cresswell. "But a lot of the processes and components have to. For example, you can't use the cadmium plate anymore, and you can't use the lead solder."

He added that the issue of qualification is particularly pertinent to energetics. "The chemical compositions allowed in rocket motors and warheads have changed. So they have to be re-qualified, which takes the time on Starstreak." **AI**

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Standing alone

In 2022, a major report into the capabilities of Irish Defence Forces recommended an upgrade of the country's Air Corps. **Alan Dron** examines what progress has been made

Picture the scenario: it is summer 2025. The conflict in Ukraine continues to rage into a third year, and relations between Russia and the West are still deteriorating.

At the start of a significant exercise, NATO radars in Norway and Finland detect large groups of Russian Long-Range Aviation Tupolev Tu-95 Bears

In Irish service, the AW139 is a true multi-mission helicopter. Alongside its traditional troop/cargo transport, air ambulance and aerial firefighting roles, the AW139 also supports soldiers from the Army Ranger Wing

Joe Campion/Key Publishing unless stated



CLOCKWISE FROM ABOVE:

A recent report on the Irish Defence Forces recommended that a minimum of eight super-medium helicopters are procured to replace the IAC's current AW139 fleet, as well as additional fleets of associated utility and training helicopters

The crew of AW139 bring the utility helicopter into the hover over Blessington lakes in County Wicklow while practising aerial firefighting operations

Six Leonardo AW139s make up the IAC's main rotary component. The Commission on the Defence Forces has recommended that a further two be purchased

Leonardo





Order of battle

The Irish Defence Forces' website details the following Air Corps equipment:

- 7 Pilatus PC-9M (operated primarily in the fixed-wing pilot training role)
- 4 Pilatus PC-12 (multi-role – passenger, cargo, medical and surveillance tasks)
- 6 Leonardo AW139 medium-lift helicopters (troop transport, air ambulance, utility). Scheduled for replacement by 2030
- 2 Eurocopter EC135 P2 (helicopter training and multi-role) plus two EC135 T2 operated in support of the police. Scheduled for replacement by 2030
- 2 Airbus C295 (maritime surveillance)
- 1 Airbus C295 (troop transport)
- 1 Learjet 45 (VIP transport and medical transfers)
- 1 Britten Norman Defender 4000 (operated in conjunction with the Department of Justice, Equality and Law Reform)

The Air Corps is based at Casement Aerodrome, Baldonnell, Dublin, and consists of an operational headquarters, two operational wings, two support wings, the Air Corps Training College and a Communication and Information Services Squadron. On a day-to-day basis, the Air Corps undertakes Army Support and Fishery Protection Patrols and provides a Ministerial Air Transport Service (MATS).



and Tu-22M *Backfires* taking off from airfields around Murmansk.

Swinging west around the top of Norway, they turn southwest down the Norwegian Sea before splitting up. One unit passes between Iceland and the Faroes before turning south, some 200nm off the coast of Ireland, crossing into Irish-controlled airspace.

And Ireland, at this point, can do nothing about it. Lacking not only the interceptor aircraft to escort the visitors out of its airspace but even the necessary long-range radars to plot the course of the Russian squadrons, Ireland instead has to rely on RAF Typhoons, supported by Voyager tankers, launching from their Scottish base to keep tabs on the bombers.

And would such an action, effectively providing air cover for Ireland, trigger a 'Thank you' from Dublin to London? As things stand, probably not – certainly not officially.

Handling real threats

The Republic of Ireland has long had minimal armed forces. A policy of neutrality stretching back almost a century means that the country is not part of NATO (although it is a long-standing provider of troops to United Nations peacekeeping forces).

However, the increasingly tense international situation and the realisation – at least among some Irish people – that the country has virtually no credible defence forces and would be unable to handle any real threats – led to the creation of a Commission on the Defence Forces, which issued its report in February 2022.

The Irish Air Corps (IAC) is a small service whose primary roles are border patrol, surveillance and aid to civil power in various forms, such as assisting the country's police force and providing medevac flights. For example, the IAC offers a long-standing emergency inter-hospital transfer service within Ireland and the United Kingdom. In addition, the IAC also supports the Republic's Emergency Aeromedical Support service.

In its report, the Commission offered the Irish government the choice of three 'Levels of Ambition' (LOA) that would provide varying degrees of capability.

Regarding the Air Corps, LOA1 was deemed essentially business as usual, an option the Commission felt needed to be revised. Ireland, for example, has a huge area of the North Atlantic in its Exclusive Economic Zone, or EEZ (about five times the country's area) that contains valuable fishing grounds and requires surveillance. It also has to cover the corresponding Irish-controlled airspace, but it currently has no means to do so.

Not only does it not have any combat aircraft capable of intercepting





potentially hostile foreign military aircraft or hijacked civilian airliners, but it does not even possess the necessary long-range radars to provide a Recognised Air Picture (RAP) of the area. Current capabilities are such “as to effectively mean that the State has no air defence capability of any significance”, the Commission admitted.

LOA2 would consist of an ‘enhanced’ version of the current situation. This would include surveillance of Irish-controlled airspace, support to the Irish Naval Service of territorial waters, the country’s EEZ and the extended Continental Shelf, and tactical transport services to the other Irish Armed Services.

The Commission noted that the lack of a RAP “is a clear weakness in our air defence capability in that this deficiency effectively allows military aircraft from potentially hostile states to test our air defence responses, and those of our neighbouring states” – ie the UK. The Commission therefore said that development of a primary radar capability “should be an immediate and top priority for the Air Corps under LOA2”.

It also called for the procurement of an aircraft with strategic reach that would be able to support Irish troops in peacekeeping missions in Africa or the Middle East and repatriate Irish citizens in need. The aircraft should also provide a cargo lift capability and transport government ministers. In addition, a replacement for the current ministerial



transport LearJet 45 should be acquired. The LearJet is scheduled to exit service imminently.

Recognising a likely continuing shortfall in strategic reach, the Commission also asked for consideration of “entering into a partnership arrangement with other countries for access to strategic airlift capabilities on an ‘as required’ basis”.

Regarding rotary-wing capabilities, it said two additional medium-lift helicopters should be acquired to join the existing six Leonardo AW139s.

When that fleet is due for replacement around the end of the decade, it would be upgraded to eight super-medium helicopters. That category includes the Leonardo AW189 and the Airbus H175M.

The Commission also called for procuring remotely piloted air systems (RPAS). It warned that the increasing use of drones posed a growing threat both to military aircraft and to critical national infrastructure. This meant that “the Air Corps should develop effective anti-drone or counter-UAS capabilities as a matter of urgency”.

Other recommendations included “the urgent re-establishment of both a first and second-line Air Corps Reserve with a particular focus on recruiting specialists such as trained pilots, technicians and air traffic controllers”.

Under LOA2, the Air Corps would be in a position to deliver enhanced air power across land, sea and air domains, including increased support to the



Army Ranger Wing/special forces and shipborne and overseas deployments.

LOA3, the highest standard, involved developing “full spectrum defence capabilities” akin to those of similarly sized European nations.

Under LOA3, the Commission envisaged that building on the arrival of primary radar, the Air Corps would develop air combat and intercept capability by acquiring a single squadron of jet combat aircraft that would be “allied to developing associated operational, infrastructure and support arrangements”.

It continued: “A move to LOA3 would also involve a further step change increase from LOA2 in organic reach and lift capability through the acquisition of two or three troop carrier-type aircraft.

“The Commission also considers that LOA3 would allow the overseas deployment of combat aircraft, pilots and support personnel to provide organic intra-theatre mobility based on tactical transport helicopters, with a minimum capacity being to move a platoon of personnel at will in an operational area. Deployed forces would also have an organic helicopter combat SAR capability.

“Such aircraft would be armed and equipped to operate in hostile environments, providing ground forces

CLOCKWISE FROM LEFT:

Ireland's current fleet of eight PC-9Ms entered operational service in 2004 and is operated by the FTS at Casement Aerodrome, Baldonnel

Ireland operates four PC-12s. The three PC-12NG Spectres were delivered to the IAC in September 2020 as replacements for the air arm's fleet of ageing Reims Rocket FR172H aircraft. A fourth, non-modified PC-12 was acquired by the Irish government to address a shortfall in the nation's airlift capabilities

An aircrew member from No 104 Squadron leaves a PC-12NG Spectre after completing an ISR training flight. The type has fully established itself as a vital asset in Irish military operations

A student PC-9M pilot conducts pre-flight checks with a QFI from the IAC's FTS before departing for Shannon Airport in County Clare on a training flight



with agile and effective fire support.”

However, moving to LOA3 would involve significantly higher spending levels, two-and-a-half to three times the defence budget of recent years.

Defence funding

Whether Irish public opinion would agree to such an increase remains open to question.

Ireland spends around €1.1bn a year on defence, and the government plans to raise that to €1.5bn by 2028 to meet the LOA2 standard.

The Commission's report admitted that “compared to our peers in western and northern Europe, it is obvious that Ireland is an outlier about defence funding”.

Just how much of an outlier is made clear in the CIA World Factbook reference work, which put the country's 2022 budget at an astonishingly low 0.3% of GDP. This contrasts with the suggested minimum of 2% for NATO nations, around seven times higher. (It is only fair to note that several European NATO nations also fall short of the 2% mark, but none by as much as Ireland.)

By comparison, Denmark, which in population terms is almost the same as Ireland, currently spends around €3.6bn a year on defence, or around 1.4% of GDP and plans to increase this to the NATO minimum of 2% in the next few years.

A follow-up document to the Commission's report in the summer of 2022 laid down timelines for acquiring ➤

various projected aircraft and radars, with several scheduled for purchase in 2025-2028.

But has anything happened?

According to James Hackett, head of the Defence and Military Analysis Programme at the International Institute for Strategic Studies (IISS) in London: "A new agreement between Ireland and NATO was reached in February, reportedly focused on improving information sharing and critical infrastructure protection.

"But political debates aside, there is evidently a renewed focus on security, on perceived threats and weaknesses in Ireland's current capabilities, what Ireland can and should be able to do about these and the degree to which there should be co-operation with external actors.

"There is also scrutiny of Defence Force capabilities in light of increased awareness of Russian military activities close to Ireland and continued activity by narcotics traffickers. The capabilities available to Ireland's Defence Forces, equipment availability and measures including budgets, personnel recruitment and retention are all in focus."

Hackett noted that official documents "indicated an ambition to move to 'Level of Ambition 2' (LOA2) by 2028, but important is whether these plans and budgets and policy attention are focused and flexible enough to keep pace with security challenges".

Hackett said that achieving LOA3, including 'full spectrum' conventional capabilities, notably the squadron of combat aircraft, would likely be "some time off" due to budgetary and organisational realities.

In the near term: "Discussions are reported to be under way to procure primary radars to help develop a recognised air picture, and the [Commission's] Implementation Plan, issued in late 2023, indicated that a requirements phase for Uncrewed Aerial Systems in 2024 with contract delivery mooted for Q2/Q3 2025."

Regarding maritime surveillance: "The geographical area to be covered – and the persistence required – lends weight to a UAS capability, and in that, a system capable of



operating at reach over the Atlantic."

Taking a somewhat bleaker view of the near future, he is one of the relatively few members of the Dáil, the lower house of the Irish parliament, who take a close interest in defence.

Dr Cathal Berry, an independent member of Kildare South who spent 23 years in the Irish Defence Forces (IDF), said that "four things jump out" about the current state of play in Ireland's attempts to move to LOA2.

Reflecting on the aviation aspects of the 2022 report, Berry said there had been "almost no movement" for two years on

the acquisition of a military-grade primary radar system; no decision had been made on procuring the recommended two new AW139 transport helicopters; "absolutely nothing has happened" on the establishment of a new reserve Air Corps; and similarly, nothing had been done to upgrade the Air Corps to an Air Force, to give it 'parity of esteem' with the country's other two services.

He said the single positive event since the Commission's report was the purchase of a single Airbus C295 medium transport. This had not been part of the Commission's recommendations, but it gave the IDF a transport capability for the first time: "It's meagre, but it's a start."

Previously, Ireland has had to ask other European nations to assist in moving troops – for example, it had to call on the French Armée de l'Air when sending special forces troops to Kabul to help evacuate people when the Taliban swept back to power in 2021.

Additionally, two more C295s were bought to re-equip the maritime squadron, giving the unit "longer legs, better payload, better avionics" Berry said. But these new aircraft, while



welcome, are replacing two earlier C235s rather than increasing the fleet, he noted. The IAC is heavily involved in maritime surveillance and fishery protection duties; the Commission said that in 2020, 152 such patrols had been undertaken.

The purchase of the two C295s and equipment fit-out and support was €221m, a significant expenditure for the country.

Berry said that, on the helicopter front, the Air Corps' six AW139s are "in various states of disrepair". Recently, this led to the single airworthy AW139 being urgently re-tasked from a medical flight to have door guns fitted to take part in an anti-narcotics operation at sea.

Additionally, he said, personnel

Open secret

Effectively, a measure of air cover for the Republic is provided by the UK Royal Air Force, which has permission to fly through Irish airspace in urgent situations, he said. "Everyone knows [this agreement] exists, but nobody is prepared to admit it."

In fact, according to an article in the *Irish Times* in May 2023, a secret agreement has existed between the UK and Ireland since the 1950s that allows UK military aircraft to transit Irish airspace.

According to the newspaper, in February 2022, weeks before Russia invaded Ukraine, RAF E-8A Poseidon maritime patrol aircraft flew from RAF Lossiemouth, in northern Scotland, over



CLOCKWISE FROM LEFT:

Tasked with the maritime patrol mission, the IAC's CN235-100 fleet is due for retirement

Ireland's two new Airbus C295s are designated as 'maritime surveillance' aircraft rather than 'maritime patrol', the title applied to their predecessors, and have an improved electronics fit

The IAC operates two Airbus EC135s for its use, plus a further two for the use of the Irish civilian police

The IAC operates a sole Learjet 45XR, which is assigned to No 102 Squadron and is responsible for conducting executive airlift operations. The type is rapidly approaching the end of its useful service life and a replacement is being sought

numbers were, if anything, falling.

So, why is Ireland's defence posture so deficient?

"It's because of 'no threat perception'," Berry said. "As a result, we don't even have a ministry of defence." He added that neither an Irish intelligence service nor a national security advisor exists. 'Defence minister' is just one of several hats worn by the current deputy prime minister, Micheál Martin, who is also foreign minister. "Our junior defence minister has been appointed but has been given no powers whatsoever," Berry said.

On defence generally: "The politicians don't care because the public don't care."

A significant reason for the country's lack of interest in defence is "this mystical thing called neutrality. People think neutrality will protect them. There's almost a perception that you're morally superior because you cannot defend yourself.

"If you even bring up the topic [of defence], you're regarded as a warmonger who wants to conscript everyone into a European Union army."

Ireland is one of four European Union nations (the others are Austria, Cyprus and Malta) that are not members of NATO.

Ireland's west coast as Russian warships conducted live-fire exercises on the edge of Ireland's waters.

Eurofighter Typhoons were also scrambled from Lossiemouth at least twice in 2020 to escort Russian Tupolev Tu-95 *Bear* long-range bombers away from civil airspace controlled by Ireland.

A British parliamentarian for the constituency that covers Lossiemouth and other former RAF personnel told the *Irish Times* that it was an open secret that the UK provided airspace 'top cover' for the Republic.

However, the Irish government has not acknowledged the agreement formally.

Separately, a legal action by Independent Senator Gerard Craughwell from the upper house of Ireland's parliament – alleging the existence of an agreement dating from the US 9/11 attacks of 2001 that allows RAF aircraft to cross Irish airspace to intercept aircraft – is destined for a preliminary trial later this year, to decide whether it can go to a full-scale hearing. The government claims that such matters fall within the scope of its executive powers and should not go before the court.

Despite the recent purchases of the

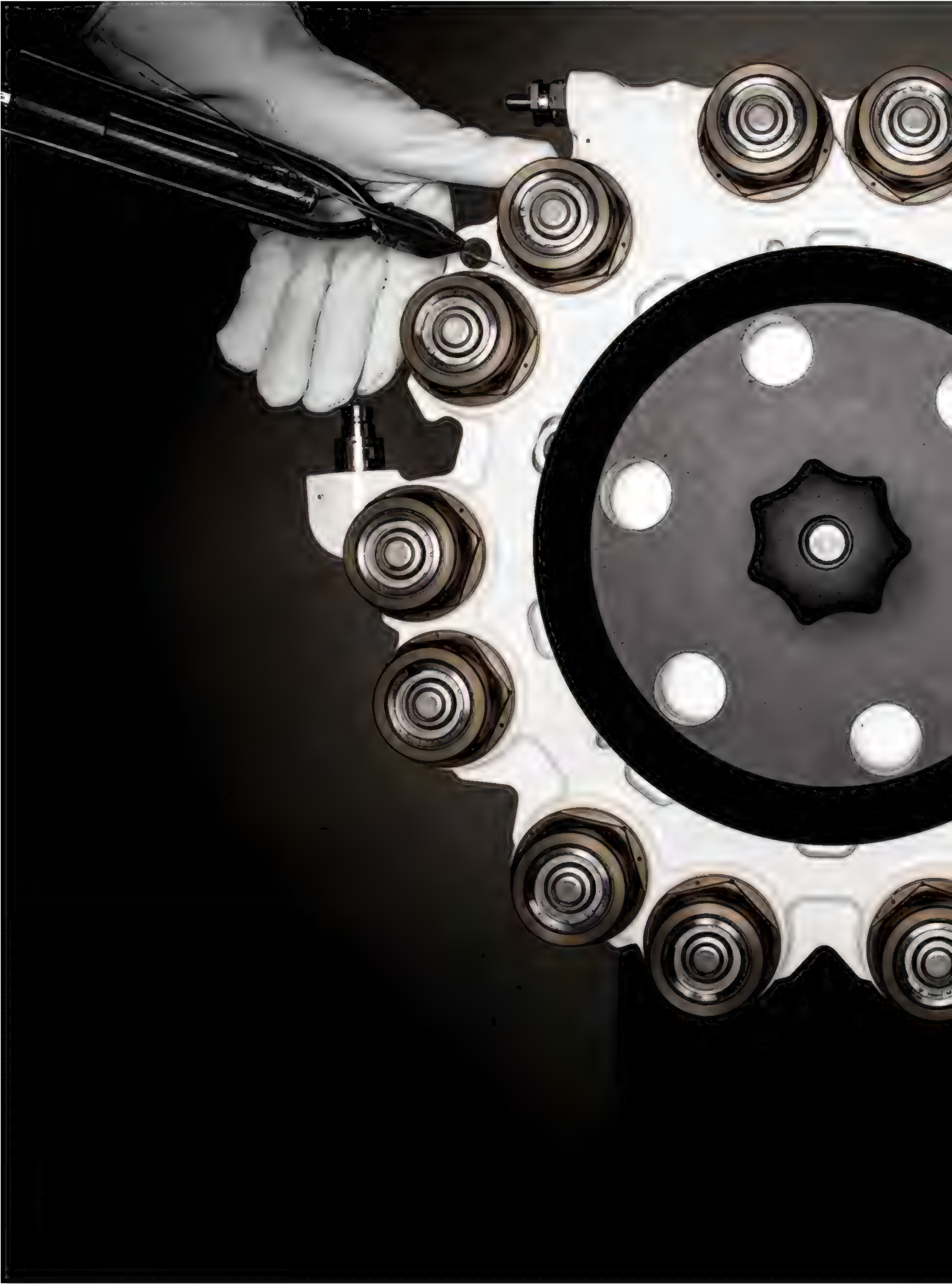
two new maritime patrol aircraft and the country's first tactical transport, at least one more major acquisition is looming for Ireland. Its fleet of seven Pilatus PC-9M turboprop trainers – which can be armed with machine guns and rocket pods for a minimal combat role – is scheduled for replacement next year. There is currently no word on what may replace them or when.

Ireland's last 'fast jet' equipment consisted of six Fouga Magister advanced trainers (that could be equipped with simple unguided underwing stores) and served from 1975-1999. Whether Ireland now has the capabilities to induct a new jet type that can undertake light combat missions in an emergency is questionable.

Given the IAC's relationship with Pilatus, the Swiss company's PC-21 turboprop advanced trainer is a possible contender as a replacement for the PC-9Ms.

In the rotary-wing sector, the AW139s and the EC135s will be replaced by 2030, another significant cost for the government.

By international standards, Ireland is a wealthy country. It remains to be seen to what extent it is prepared to pay to bolster its national defences. **AI**





Although undercarriages, wheels, and brakes may only be used for a short part of an aircraft's journey time over a particular sector, they must be made and maintained to the highest standards, as **Bernie Baldwin** reports

Geared for optimum service



CLOCKWISE FROM ABOVE:

A Boeing 787 front rod in the paint workshop at Safran
Adrien Daste/Safran

A Safran undercarriage on an Airbus A320
Adrien Daste/Safran

PREVIOUS PAGES:

A Safran centre brake component for an Airbus A320
Adrien Daste/Safran

From a certain point of view, an aircraft's undercarriage is one of the largest pieces of luggage on every flight. Carried everywhere, it is necessarily rather heavy – putting several tons of structure and passengers onto the ground at speed requires considerable strength and solidity.

As with everything carried on aircraft in these times of seeking lower emissions levels, the operators want to keep weight down. Over the years, technological developments have enabled better performance from whole undercarriage units and their constituent modules. Whether used in linefit or retrofit scenarios, advances have been made in materials science – for structural elements, wheel hubs, brake pads and so on – as well as in the processes used to create products, such as castings, forming, and latterly, additive manufacturing (sometimes known as 3D printing).

These are designed to deliver better performance, lower weight, and maintainability to the aircraft operator, ultimately aiding costs and profitability. For the OEMs, this is an ongoing challenge.

Séverine Charrie, EVP Landing Gear & Integration Division at Safran Landing Systems, reports that innovation within her division is implemented around three

main themes.

"First, we have weight reduction and performance optimisation through the development of high-strength materials – such as new grades of steel, stainless steel and aluminium – to make our products lighter, stronger and more efficient, especially in tough environments," she explains. "Next, we have new special processes and coatings to ensure better protection against corrosion and extend TBO [time between overhauls]. Thirdly, we have been studying the use of additive manufacturing to obtain complex shapes while reducing the weight of the gear."

Charrie's colleague Jean-Michel Hillion, the company's EVP Wheels & Brakes Division, Safran Landing Systems, describes the development efforts in his specialist area. "The carbon brake technology developed a few decades ago is still being expanded to the whole aircraft flying fleet," he notes. "Today, most airlines and MRO providers are fully equipped and skilled to perform services on this type of equipment, replacing steel brakes year after year."

"Carbon brakes are much lighter than steel and offer much better performance. For example, the Safran Landing Systems Boeing 737 carbon brake is the lightest on the market, up to around 700lbs (320kg) compared with the steel brake

for that aircraft type. This enables the operator to add three extra passengers," Hillion remarks.

The EVP says that Safran Landing Systems' carbon brakes offer higher performance because of better energy absorption (claimed to be approximately three times better than steel brakes), more braking efficiency, and faster cooling down. Such attributes enable shorter turnaround times (TAT), thus increasing fleet availability.

"Carbon brakes provide operators with a much longer life on-wing than steel brakes, reducing the number of aircraft disruptions," he adds. "Our carbon brakes average 2,200 landings per overhaul [LPO], ensuring twice the endurance of regular steel brakes and providing considerably lower operating costs for airlines.

"In addition, shop visits for carbon brakes require less labour time than those for steel brakes, as carbon disks do not require specific maintenance operations, contrary to steel disks. Hence, this positively impacts the maintenance cost of wheel and brake services, as well as turnaround time and spare stocks for the operators," Hillion confirms.

Developments made at the OEM level quite naturally have a knock-on effect for those charged with maintaining undercarriages, wheels, and brakes.

Ismaël Fadili is vice president of sales–Europe for AMETEK MRO, and he, too, has been observing developments in the various systems that make up complete undercarriage units.

Fadili believes, however, that "very few new technologies have been developed for the whole system during the last 20 years". He picks out some which have come to market.

"The main step has been for brakes, with a move from steel to carbon for the heat sink qualities, the result of which has been to increase the MTBUR [mean time between unscheduled removals]," he comments. "The industry is now moving towards using electric brakes, but it's a bit too early to understand the benefits of installations on new platforms.

"The next step will be to treat the surface of landing gears, but this is more in response to environmental constraints rather than contributing to better system performance," Fadili says.

While acknowledging that these few elements do help improve performance, Fadili remains consistent regarding the big picture. "As said before, there are no recent technologies that could be game changers for the whole system," he emphasises.

Regarding maintainability, advanced technology enables the development

of repairs that were impossible before. These are often undertaken instead of replacing parts. Aircraft operators are looking to both OEMs and MRO specialists to realise benefits such as cost savings, increased safety, and better operational flexibility from the latest repair developments.

To a certain extent, of course, the MRO providers have to look to the OEMs for help here. "As far as the landing system is concerned, we cannot deviate from the CMM (component maintenance manual), especially for commercial aircraft," Fadili confirms. "Having said that, at ANTAVIA/AMETEK MRO enhancements are mostly coming from improvements in our processes using automatic systems for stripping, NDT [nondestructive testing], and scanning. It is part of our operational expenditure programme, generating cost savings, improving our capacities, and generating reliability for our customers."

Maintaining undercarriage systems goes much further than devising new repairs that previous technologies were not capable of delivering. Being ready for an event that demands repair or overhaul of a landing gear module is increasingly important. Safran Landing Systems can offer such assistance via its Landing Gear & Integration Division.

"Health monitoring and predictive



maintenance systems are enabling us to work in anticipation to avoid future breakdowns,” says Séverine Charrie. By using and studying data, we can detect weak signals that could lead to a breakdown, anticipate the removal and repair of the gear, and thus reduce the costs associated with these operations.”

Brakes can also be monitored, ensuring the tonnage is brought to a taxi speed and eventually to a complete halt without incident. While the idea of some level of brake repair might seem implausible, Jean-Michel Hillion explains that it is not necessarily the case.

“For carbon brakes, we can ‘remanufacture as new’ – also known as ‘refurbish’ – the brake carbon disk such that in some cases, more than 50% of the carbon disk can be recycled and reused. A new disc, once worn, may have up to four usages throughout its lifecycle,” he elaborates.

For anyone unsure of the process’s efficacy, Hillion is quick to allay any concerns. “This process ensures the same level of performance and safety,” he declares. It contributes to significantly lowering the usage of new carbon disks and the associated materials and energy they require to be manufactured.”

The process, therefore, offers reduced costs by paying for a refurbishment rather than a new part, but it has an environmentally friendly component by being more energy efficient overall.

No matter how an OEM or an MRO provider develops a new repair for undercarriage systems and their constituent parts, safety remains paramount. Hence, the repair has to be approved for commercial use. “Any new part or repair solution developed



to support the fleet is developed, tested, and certified under the control and authority of aircraft designers and airworthiness authorities,” Hillion confirms.

On its website, AMETEK MRO declares that “‘repair versus replace’ is always our philosophy.” It adds that each of the company’s nine businesses has access to the latest CMMs and technical documents and dedicated technical teams ready to solve complex repair requests. “Our organisation prides itself on finding cost-effective answers in the fastest possible turnaround time for our customers,” the company states.

Similar to Safran’s Hillion, Fadili highlights the regulatory aspect of developing repairs. “Very few new repairs can be done outside of the CMM, and the OEM or the airframer must approve these,” he avers. We can deviate with some DER [Designated Engineering Representatives] repairs or PMA parts with the airline’s approval, but for this type of component, it is really limited.”

To help aircraft operators plan their



CLOCKWISE FROM LEFT:

Work at the Safran Landing Systems site in Walton, Kentucky, USA
Alex Marc/Safran

Wheel and brake repair at AMETEK MRO Antavia
AMETEK

Inspection of a brake system at Antavia, one of the nine businesses within AMETEK MRO
AMETEK

undercarriage maintenance and control costs, as they like to plan ahead with an element of certainty – particularly in areas such as parts provision, logistics, predictive analytics, and budgeting—the OEMs and MRO companies offer integrated aftermarket solutions.

Within these support programmes, there are often a variety of services that can be tailored into a bespoke package for the operator. This can include, for example, parts pooling for those parts that can be repaired or a supply chain that ensures minimum stock levels of consumables.

“At AMETEK MRO through the ANTAVIA business, we offer loans for landing gears or dummy gears to support aircraft operations during the maintenance period,” Fadili reports. Additionally, pool stock can be made available to exchange wheels and brakes. Most importantly, we hold a high-level spare parts inventory to support our programmes, including consignment stock negotiated with the OEMs and their distributors.” ➔



“The industry is now moving towards using electric brakes, but it’s a bit too early to understand the benefits of installations on new platforms”

Ismael Fadili, vice-president sales Europe, AMETEK MRO



linked to the level of activity (cost per landing), reports Jean-Michel Hillion.

Fellow EVP Darren Waite heads up Safran Landing Systems’ Customer Support & Services division and adds his take on the aftermarket support that customers can expect. “As an OEM and leader in aircraft landing solutions, Safran Landing Systems offers its customers service-by-the-hour packages, which can also include predictive maintenance,” he begins. These ‘tailor-made’ solutions aim to optimise the operational cost and availability of our customers’ fleets while guaranteeing a very high level of service to meet their specific needs.

“Safran Landing Systems benefits from its own internal MRO network, which covers all maintenance and overhaul activity. Our complete range of Support and Services is available through our aftermarket brand ‘Landing Life,’” Waite adds.



Machining line at Safran is dedicated to Boeing 787 landing gear
Christian Fleury/CAPA Pictures/Safran

The company’s efforts across its portfolio have certainly brought results in the way of new business. In January 2024, ASL Aviation Holdings and AMETEK MRO’s AEM business announced a new agreement to provide landing gear services for ASL’s European fleet of Boeing 737 Next Generation and Classic aircraft. The deal covers the provision of overhaul services and loan gear sets until the end of 2026 and builds on ASL’s existing relationship with AEM, which has been an ASL-trusted supplier for many years.

As might be expected in a company the size of Safran, integrated support programmes for undercarriage, wheels, and brakes are available to operators across the full range of services. “Safran develops different types of contracts that encompass the whole support of the wheel and brake in operations including exchanges, support stocks and cost fully

An excellent example of Safran Landing Systems’ success in this area came in late 2023 when the company signed a five-year contract with Wizz Air to carry out the MRO operations on 57 aircraft of the carrier’s Airbus A320 family fleet. These services are being provided by Safran Landing Systems’ MRO facility in Gloucester, UK.

Since signing the contract, Safran Landing Systems has already successfully carried out maintenance operations on several Wizz Air landing gear legs. As noted above by Waite, this contract also falls under the Landing Life customer portal.

‘Large luggage’ they may be, but the vital work in developing and maintaining aircraft undercarriage is never underestimated. From large castings to lighter but still sizeable carbon brakes, every element is meticulously constructed and assembled—and cared for in service to ensure integrity and safety. **AI**

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'DO MO

What progress has there been on the journey towards decarbonising aviation?
What are the latest developments and broader global influences?

Mark Broadbent reports



RE and faster'

New technology, fuels, infrastructure and improved operations are all required to meet the International Civil Aviation Organization (ICAO) challenge of net-zero carbon dioxide (CO₂) emissions by 2050. The aerospace community has notably pushed towards new-generation aircraft

and engines using electric/hybrid-electric and hydrogen technologies in recent years. The Embraer Energia and Airbus ZEROe projects and work by agencies such as NASA and Germany's DLR are among the various research and development initiatives under way.

Actual products are in development, too. ZeroAvia is flight testing a ZA600 hydrogen-electric fuel cell prototype →

Airbus's ZEROe project is one of the various initiatives under way in hydrogen research
Airbus





aboard a Dornier 228 aircraft from Kemble, Gloucestershire. Dan Allawat, ZeroAvia's chief strategy officer, said in April 2024 that the company "is rapidly advancing towards certification".

Universal Hydrogen said in March this year that it had successfully run a megawatt-class fuel cell powertrain using its proprietary liquid hydrogen module. The module powered the company's 'iron bird' ground test rig for more than an hour and 40 minutes to simulate a regional aircraft flight profile.

Several start-up developers have electric aircraft projects, including Heart Aerospace, whose ES-30 regional airliner has attracted orders and letters of intent from Air Canada and United Airlines, among others.

Industrial strategy

Airbus says hydrogen is lighter than Jet-A while offering considerable energy density (three times more than conventional fuel).

Several organisations involved in hydrogen R&D in the UK have formed the Hydrogen in Aviation (HIA) alliance, comprising easyJet, Rolls-Royce, Airbus, Ørsted, GKN Aerospace, Bristol Airport and ZeroAvia.

In March 2024, the HIA published a report outlining the steps and timeline industry and the UK government need to follow to secure global leadership in hydrogen-powered aviation.

A HIA statement called for an "industrial strategy" for the sector: "The UK will need to secure massive increases in hydrogen supply. This will involve the accelerated deployment of renewable energy generation and significant investment in hydrogen infrastructure and skills."

The HIA issued six recommendations: measures to industrialise hydrogen, resourcing the UK Civil Aviation Authority on certification/regulations, developing

hydrogen infrastructure at airports, pursuing government support/incentives, scaling up production to ensure sufficient supply and improving workforce skills/training.

First to take the chair of the HIA is Johan Lundgren, CEO of easyJet. He said: "The breakthroughs in hydrogen-powered technology happening across the UK are truly astonishing, but these advances will be inconsequential if we fail to complement them with the appropriate skills, infrastructure, investment and regulation needed to support hydrogen aviation."

Project ACORN

An airside refuelling trial recently completed at Bristol Airport was a recent example of an activity to advance hydrogen in aviation in the UK.

Hydrogen was used to refuel and power ground support equipment (GSE) – specifically, a MULAG baggage tug – servicing easyJet passenger aircraft. Conducted alongside the airline's daily

operations, the trial was intended to show that hydrogen can be safely and reliably used to refuel GSE at a busy airport.

The trial, which had been in development for more than a year, involved Jacobs, Cranfield Aerospace Solutions, Connected Places Catapult, DHL Supply Chain, Fuel Cell Systems, the IAAPS research institute, Globe Fuel Cell Systems and TCR.

A Cranfield Aerospace Solutions statement said the trial's results "are set to help develop industry standards, provide guidance to airports, airlines, local authorities and regulators on required infrastructure changes, and support the development of a regulatory framework for hydrogen's use on an airfield".

EasyJet's chief operating officer, David Morgan, said: "While the technology is advancing at an exciting pace, as hydrogen isn't used in commercial aviation today, there is currently no regulatory guidance on how it can and



should be used.

“Trials like this are significant in building the safety case and providing critical data and insight to inform the development of the industry’s first regulatory framework. This will ensure that regulation keeps pace with innovation and supports the industry in meeting its decarbonisation targets by 2050.”

Sustainable aviation fuel

The challenges around hydrogen in aviation – infrastructure, production, supply, regulations and usage – along with the limitations of electric flight (regarded as better for shorter-range operations due to battery demands), mean sustainable aviation fuels (SAFs) are seen as crucial in meeting the 2050 net-zero goal.

Speaking during a webinar hosted this March by aviation consultancy IBA, Haldane Dodd, executive director of Air

the last few years.

Dodd said: “The supply is definitely increasing. We are seeing a real shift in the way the industry is responding. In the last two-and-a-half years we’ve seen a real uptick in the number of offtake agreements and the number of new plants being announced. That’s really important – we need to keep that momentum going.”

In February this year, International Airlines Group, which has committed to using SAF for 10% of the group’s fuel usage by 2030, announced a 14-year agreement with the US company Twelve to supply SAF to its airlines.

The following month, Southwest Airlines said it had invested in LanzaJet to open an ethanol-to-SAF production plant in Georgia in the United States. Emirates is now using Neste SAF at Amsterdam Schiphol Airport. The Gulf carrier will use



Transport Action Group (ATAG), said: “Out until 2050, SAF is going to be the more important solution for us. SAF allows us to use the aircraft already in our fleet, and we’ll be continuing to use them over the next couple of decades.”

In November 2023, an agreement on SAF at the third Conference on Aviation and Alternative Fuels (CAAF/3), convened by the ICAO, meant governments from more than 100 states set a goal that aviation fuel in 2030 should be 5% less carbon-intensive than the fossil-based aviation fuels used today.

The industry is moving to adopt SAF on a large scale, as is shown by the blizzard of announcements from carriers worldwide concerning SAF purchases in

two million gallons of blended SAF in the Schiphol fuelling system in 2024.

In April 2024, DG Fuels, which describes itself as “an emerging leader in renewable hydrogen and biogenic-based, synthetic SAF and diesel fuel”, announced plans for a US\$4bn SAF production plant in Louisiana.

The proposed facility would be the world’s largest SAF production facility, DG Fuels said, with a planned capacity of 13,000 barrels per day – “capable, after blending to 50%, of producing enough SAF for more than 30,000 transatlantic flights annually”, the company reported.

DG Fuels has already secured offtake agreements with Delta Air Lines and Air France-KLM Group and has a strategic

CLOCKWISE FROM ABOVE

Universal Hydrogen tested a megawatt-class hydrogen fuel cell powertrain

Universal Hydrogen

DG Fuels’ proposed SAF production plant in Louisiana has a planned production capacity of 13,000 barrels per day

DG Fuels

Emirates now uses SAF at Amsterdam Schiphol Airport

Emirates

partnership with Airbus to scale up the use of SAF globally. Based on the Louisiana plant, DG Fuels is planning ten more SAF production plants across the United States.

Notable flights using SAF continue. Gulfstream undertook a transatlantic flight powered by 100% SAF on November 20 last year, using a G600 demonstrator between Savannah, Georgia, and Farnborough, Hampshire, shortly followed by the first 100% SAF-powered commercial flight, by a Virgin Atlantic Boeing 787-9, which flew from London/Heathrow to New York/JFK.

Investment case

It is essential to bring together all parts of the commercial aviation ecosystem – airports, airlines, aircraft manufacturers, SAF suppliers, ATC providers, regulators and others – to mitigate aviation’s environmental impact.

ATAG’s Dodd insisted in the March 2024 IBA webinar: “It’s an enormous challenge, but it is doable. We’re running out of time to make that happen – we need to ensure that these next five to ten years we’re on the right track.”

Dodd noted: “It’s a process of making sure we can scale up and convince the financial community to have their role in this process. We will need potentially 1.5 trillion dollars’ worth of capital investment in SAF production over the next 25 years. That money has to come from somewhere.”

During the webinar, Phil Seymour, president of IBA, said: “The folks we talk to are primarily the asset financiers. Making the case to finance something burning hydrocarbons is becoming more difficult. If we’re not careful as an industry, we could scare a lot of banks away from aircraft finance.”

Yet aerospace will still need finance; of course, connectivity aviation will continue. Dodd noted: “Most banks are joined up to the Net Zero Banking Alliance and have commitments to decarbonise their



portfolio. Investing in SAF and re-fleeting to reduce the amount of fuel – putting the most efficient aircraft into use – helps to balance that portfolio.”

Supply and demand

Jennifer Stanley, IBA manager of ESG (environmental, social and governance), pointed out the essential measures to encourage SAF adoption in the airline business. She added that demand-side measures include blending mandates, direct tax incentives, ticket fees and domestic cap/trade arrangements. Supply-side actions include growing SAF supply through innovation funds, grants and tax exemptions.

ATAG’s Dodd said: “If you just have demand-side measures, ie, a mandate, by itself, that’s not going to create the kind of long-term investment and scale-

“It is essential to bring together all parts of the commercial aviation ecosystem – airports, airlines, aircraft manufacturers, SAF suppliers, ATC providers, regulators and others – to mitigate aviation’s environmental impact”



CLOCKWISE FROM LEFT:
Gulfstream undertook a transatlantic flight powered by 100% SAF on November 20, 2023, using a G600
Gulfstream Aerospace
Heart Aerospace’s ES-30 turboprop is one of several aircraft in development using electric technology
Heart Aerospace
A MULAG baggage truck was used in the Bristol Airport hydrogen trial
Cranfield Aerospace Solutions

up of SAF we need.

“If you just have the supply side, sometimes [there are] questions as to whether those projects are bankable because there might not be the offtake guarantee. The best world is a mix of both – the supply side with potential back-up measures on the demand side.”

Some countries have more ability to assist on the supply side than others. Dodd said: “We’ve seen that with the Inflation Reduction Act in the United States, but you’ve got a lot of the world – particularly developing economies – that just don’t have the treasury ability to finance those types of incentives.

“[Other countries] need to think about other options, including tax exemptions on construction and looking to outside funding sources to ensure we can bring the SAF industry to countries worldwide.” ➡



RIGHT:
In a recent trial, hydrogen was used to refuel and power ground support equipment at Bristol Airport
Cranfield Aerospace Solutions

BELOW:
Working with different organisations from across the industry, as seen in this Project ACORN infographic, is integral to attaining net zero
Cranfield Aerospace Solutions



Big picture

IBA's Stanley noted during the webinar that in 2024, more than 40 elections are taking place worldwide, including the US Presidential Election, the UK General Election plus ten in Asia.

Might government prospect changes in many places – and other persistent 'big-picture' influences like economic trends – affect support for net zero?

ATAG's Dodd acknowledged: "Big issues you're trying to deal with at a global level are multi-decade issues. Trying to reconcile that with electoral cycles is always quite a challenge."

Business ultimately likes certainty to make policy decisions, as Dodd added: "You tend to find a lot of corporates say, 'well actually, this is really important for us in the long term. We're just going to keep doing the climate action the way we were already'. Hopefully, that corporate responsibility can take over to a certain extent."

More widely, flooding and wildfires are now more common in developed economies, not just developing ones, as Dodd commented: "We are starting to feel climate impacts now in a way we haven't until the last two or three years, and so I think there's going to be a fundamental shift in the way citizens start thinking."

ETS change

The regulatory picture also comes into the equation. Since 2012, carbon dioxide emissions from aviation have been included in the European Union Emissions Trading System (EU ETS).

Under the ETS, all airlines operating in Europe – including non-European carriers operating on the continent – are required to surrender allowances against their emissions. They receive tradeable allowances up to a certain level of emissions from their flights per year.

According to the European Commission: "The system has so far contributed to reducing the carbon footprint of the aviation sector by more than 17 million tonnes per year, with compliance covering over 99.5% of emissions."

In December 2022, the EC announced updated ETS rules from 2026. It said: "The industry will have a greater responsibility to pay for its carbon footprint, and there will be more economic incentives to reduce emissions due to a robust price signal."

In addition to ETS, the European Commission also plans to assess the ICAO Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in 2026 to "see if it is sufficiently delivering on the goals of the Paris Agreement".

The EC also intends to introduce a support scheme to speed up the use of SAF –

financed with EU ETS revenues – and "create a new system for airlines to monitor, report and verify non-CO₂ emissions".

Further ahead, IBA's Jennifer Stanley noted that 2030 will see the start of mandatory CO₂ reporting for individual airlines: "European carriers are going to face much higher offset obligations from 2026," she said. "Is that going to be passed on to customers?"

'Challenge of a lifetime'

Back on SAF, Dodd emphasised: "We need to do more and faster. We're not just going to coast to 2050 and net zero – we must work hard at this."

Dodd said that ultimately, "we like flying, planes and aviation; that's our job, getting people and cargo to their destination". But tackling emissions and attaining net zero is "not only on us to do that – we need governments on board with the right policies, the energy industry and the finance industry to help make that a reality".

Nevertheless, he added: "The question is not 'will we meet a net zero goal?'. We have to if we're going to have an industry in 2050 that connects the world the way we do today. The question is, 'how will we meet this goal?'."

"We went from the Wright Flyer to the jet engine in 40 years. The Second World War was the one thing that pushed the development of the jet engine. We need a war footing on climate change as well – we're facing the challenge of a lifetime."

Dodd said a united industry, knowledge about where the sector must go and a global organisation (ICAO) to drive things helps. IBA's Phil Seymour pointed out: "Most governments are aligned, most financiers are aligned. Everybody in aviation knows, with the growth of air travel, we have to take some responsibility."

Dodd emphasised that SAF is a lever that can now be pulled to advance commercial aviation's progress towards net zero: "We don't need to wait for the technology to be developed," he said. "It's a finance and economics question – we just need to get the money into the system. I'm optimistic that we can get there." **AI**

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The B-1B carries a heavier conventional bombload than any other bomber in the US Air Force inventory. After 39 years in service, the 'Bone' is set to continue flying out to the late 2030s and beyond. Originally an atomic bomber, the B-1 switched to an exclusively conventional role in the mid-1990s.

Since then, the aircraft has demonstrated great versatility, proving itself to be an excellent PGM delivery platform, as well as being cheaper to operate than the B-52H and B-2A! Though only about 45 aircraft remain in service, many regard the B-1B as the backbone and mainstay of Air Force Global Strike Command (GSC).

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Absolute

Air International spoke with **Neil Russell**, CEO of Aero Norway, a leading global engine MRO provider, about how the sector has bounced back after some lean years and the challenges ahead



Aero Norway, the independent engine MRO provider and trusted partner for customers operating CFM56-3, CFM56-5B and 7B engines, is focusing on a dedicated strategy that will see stability and investment deliver tangible customer benefits. The plan is underpinned by a rigorous evaluation of processes and procedures, covering all areas of the business, from the development of its people to the augmentation of its industry-renowned capabilities. "By continually assessing and improving our processes, we can offer the best service provision to our customers as well as strong support for our team," says CEO Neil Russell.

Aero Norway aims to keep its customer base as wide as possible across all global regions. The primary focus has always been on smaller airlines operating at most 40 aircraft because they can customise programmes and inductions according to their needs. The CFM56-5B is the engine choice of the global A320 family due to its high reliability and durability, and the CFM56-7B is exclusively powering the B737 NG – making it the most popular engine combination in commercial aviation.

To amortise the impact of COVID-19, extensive measures were put in place during 2020/21 to ensure that the engine MRO specialist was well placed to flex with prevailing market forces and sustain its commitment to fast turnaround times. Maintaining a premium service for its customers – airlines, MROs, independent engine owners and leasing companies – Aero Norway took steps post-pandemic to underpin the business in three ways: financial support to deliver working capital; sourcing of repair partners to complement the flexibility of the lighter workscopes; and the development of a highly trained workforce to ensure continuity of skill sets. Investment in people and processes was, and still is, perceived as a critical expenditure to safeguard the organisation's future.

In addition to sustained investments in operations, Aero Norway is

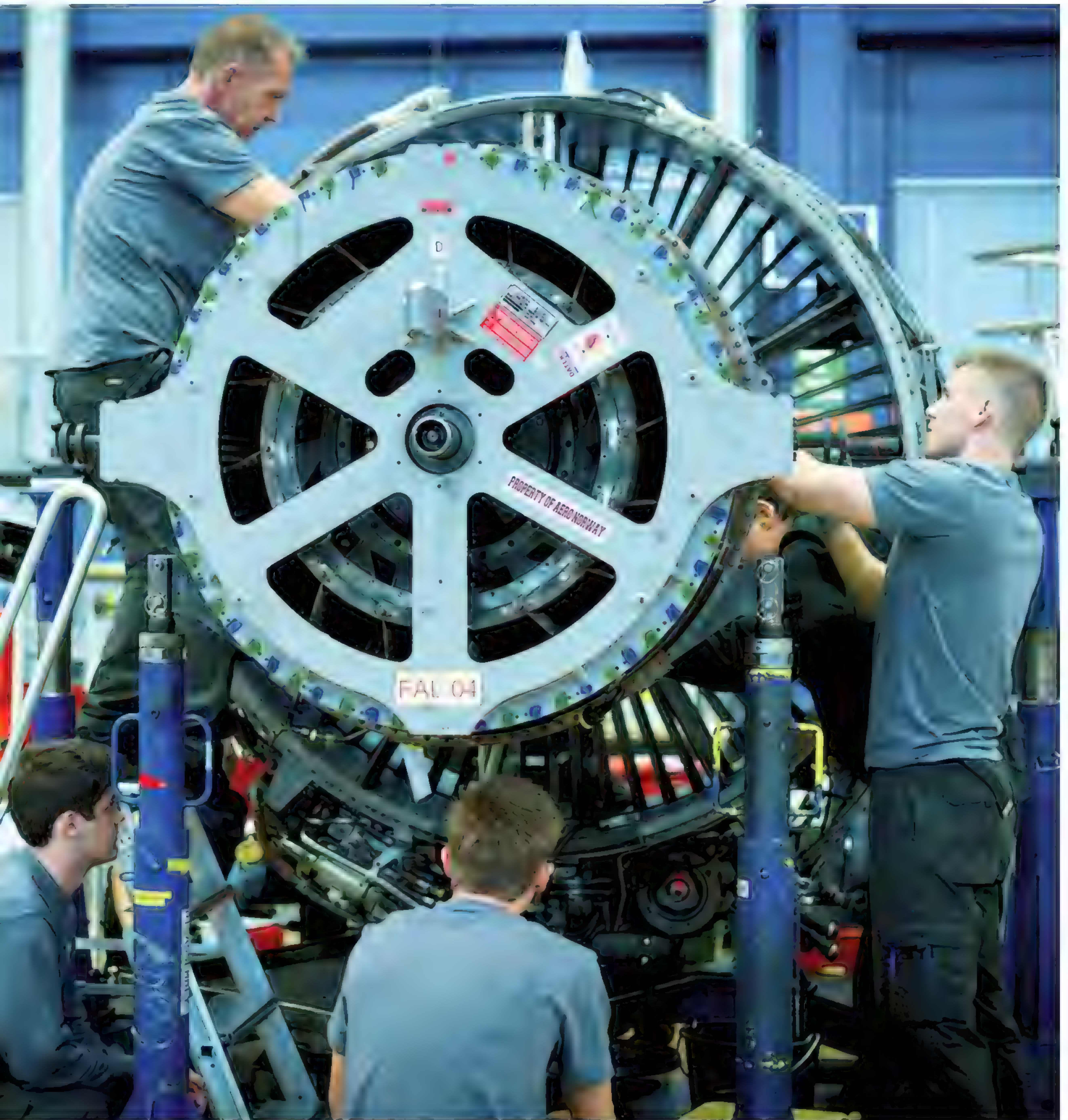


Speed and cost-efficiency combine with Aero Norway's inherent flexibility to reduce turn-around-times and bring tangible commercial benefits to operators and lessors

All images via Aero Norway

precision

at Aero Norway



always looking to augment its -5/-7 customer portfolio, which is now the facility's primary focus, while building its competitive edge. "We are pledged to support our airline and lessor customers as they transition from -3 to more -5B/7B types over the coming years," says Russell. "Simultaneously, we are committed to bringing our LEAP support programmes online in the coming months."

The company is also committed to lean excellence, implementing a path towards digitalisation, and expanding its internal repair capabilities.

Future fit

The road to transition needs one eye on the past and the other firmly focused on the future. Can Aero Norway support customers' legacy engines with increased efficiency as they manage their evolution to embrace the new-technology LEAP models? "It's vital that we do," says Russell.

Engine upgrades to the narrowbody aircraft of Airbus and Boeing have created an enormous impact over recent years, lengthening the lives of airframes, which continue to be central to air transport. While the CFM56 from CFM International has begun to make way for its LEAP engines on the A320 and the 737, there is still a vast MRO market for the former powerplant. Independent engine MROs like Aero Norway must manage ongoing maintenance and repair programmes to support the record-breaking CFM56 engine family and have a streamlined process for its successor, the LEAP engine range.

"Aero Norway is an independent engine MRO provider and we are focusing our energies on a dedicated strategy that will build on stability and investment to deliver our LEAP 1A and 1B light services before the end of 2024," explains Russell. "This transition has been underpinned by a



rigorous evaluation of all business areas, from the development of our team to the augmentation of our industry-renowned capabilities. You need the respective competencies balanced with experience. This combination truly adds value as engine repairs become more complex."

Reducing ownership cost

Operators of all CFM engines are continually seeking support packages

which benefit them in terms of price, reliability, and turnaround time (TAT). Aero Norway works with customers to understand their concerns and goals for each repair, whether they focus on cost, performance, or build life. Their engineers then develop workshops that will provide maximum efficiency and contribute towards the longevity of the particular engine in the most economical way possible. It is interesting to observe that, despite its longevity in service, new repair techniques and processes for CFM56 engines continue to be added. "We are constantly evaluating and implementing new repair capabilities that will benefit our customers and bring down the cost of ownership," Russell says.

It is almost always more economical for the end customer and more profitable for the maintenance provider to repair a part rather than replace it. It's all about balancing the customer's expectations on turnaround time, price, and pedigree of the parts installed in their engine. Aero Norway has an active trading programme, including the buying and selling of used material and the teardown of engines for parts. "Crucially, our business model is based on core-performance restoration. We know what is needed and keep those parts in stock for scheduled repairs. We maintain our inventory at as low a level as possible. Still, importantly, nowadays,





CLOCKWISE FROM LEFT:

Aero Norway's modern 14,500m² facility has a capacity for up to 120 engines per year with streamlined workflow processes to repair 16 engines consecutively

EGT refers to exhaust gas temperature, which is a measure of the performance efficiency of the engine in producing the designed level of thrust. Aero Norway provides customers with best-in-class EGT margins across the CFM56 family of engines

Skills set

Aero Norway AS is an authorised CFM repair station based in Stavanger Airport, Sola, Norway. Its modern facility offers a full range of engine MRO services for CFM56-3, -5B and -7B types including:

- Engine repair and overhaul
- Maintenance and repairs
- Engine test cell runs
- Full restoration
- Back shop parts repair
- Engine investigation
- Special customer requests
- Non-destructive testing and diagnostics

we need to factor in delays in the supply of new parts from the OEMs – the stock we hold predominantly uses serviceable material (USM). This reduces customer costs, minimises supply chain issues and is perceived as better for the environment as it 'recycles'."

Sustaining spare parts supply

From an MRO perspective, CFM's approach is unique for an OEM

because its support model is open and competitive with partners like Aero Norway. The higher degree of competition creates a channel for used serviceable parts. MROs and airlines seek out these used parts to reduce maintenance costs, and the bidding market for such parts drives a high salvage value for engines. Airlines, lessors, and investors all benefit.

Aero Norway has an active



"You need the respective competencies balanced with experience. This combination truly adds value as engine repairs become more complex"

Neil Russell, CEO,
Aero Norway



trading programme, including the buying and selling of used material and the teardown of engines for parts. The volume of material for the CFM56-3 engine has fallen less than expected over the past five years, and Aero Norway continues to complete worksopes for its customers still operating this older engine type. According to Russell, it was believed that pre-pandemic, the number of CFM56-3 engines passing through Aero Norway's facility would decline as the impetus moved towards the CFM56-5B/-7B series.

However, a significant uptick in utilisation rates by many 737 CL freighter operators translated to an urgent requirement for the completion of several maintenance tasks on the legacy engine type and the bounce back of the aviation industry with burgeoning flight demand globally, coupled with supply-chain issues affecting the delivery of new aircraft models, has seen the Norwegian specialist continue its MRO services for existing customers operating this reliable engine type.

Russell says that because CFM56 engine types are in use for longer than expected, the demand for supporting engine MRO services is increasing in tandem and is unlikely to change over

the next two to three years. The -5 and -7 models have performed particularly strongly on-wing, leading to operators delaying shop visits. However, this performance and pandemic-induced supply chain problems may mean that operators and lessors will need help to get their engines into the shop over the next year or so.

"This situation is further compounded by the current technical issues faced by LEAP and GTF engines, for example. These are good engines and the new world fleet of passenger narrowbody aircraft eagerly awaits the operational and environmental benefits they will bring. But there are difficulties to overcome, so the engine types we specialise in will be needed for the next decade or more."

All about LEAP

The LEAP engine, which only entered into service in 2016, is expected to stay on the wing longer, with heavy maintenance events at less frequent intervals. With production gradually switching from a majority of CFM56s to more LEAP engines built per year, airline maintenance departments and independent MRO suppliers will notice many improvements, notably ease of maintenance. This is a result of LEAP family engines being designed for better maintainability and cost management.

Additionally, LEAP engines are delivered with a substantial EGT margin; as that margin is consumed, the engines must be removed and restored. "A number of our existing customers are adding the LEAP engines to their fleets and we want to continue to service those customers," says Russell. "Aero Norway is renowned for delivering exceptional EGT margins, so when we look at the maintenance of these next-generation engines, we will adopt the required procedures on the technology side. All technological developments are important to us and we are moving closer to being fully paperless via digitalising all processes. This will make us faster."

A fresh Norwegian spirit

Aero Norway is recognised as one of Norway's leading aviation aftermarket businesses. The facility is multi-release FAA, EASA, TCCA, CAAC, GCAA and DGCA certified, which qualifies its worldwide appeal to operators and lessors of CFM56-type engines. If there is a business opportunity, the organisation will secure the additional approvals it needs. However, most operators and lessors find approvals from these regulators indicative of Aero Norway's credentials.

Utilising the most modern, up-to-date equipment and technology ensures that all maintenance and repairs carried out

CLOCKWISE FROM OPPOSITE

Qualified and licenced teams resolve operational issues and restore engines to serviceable conditions. Customers from flagship airlines to LCCs and aircraft leasing companies to OEMs, trust Aero Norway to solve their engine issues

Previously Aero Norway's CCO, when promoted to CEO in 2023, Russell focused on investing in more machinery, specialist equipment and training to make the business more sustainable and reduce Aero Norway's carbon footprint

Aero Norway is an authorised CFM engine repair station designed specifically for CFM56-3, CFM56-5B and CFM56-7B engines





in the Stavanger workshop, on-wing, or undertaken off-site by specialist repair vendors, are implemented with precision to the highest possible standard. Through the creation of support agreements with outstanding specialists worldwide, Aero Norway is focused on enhanced operational efficiency, enabling it to maximise the fast slot induction and quick turnaround that its global customers demand.

"We like to have a small portfolio of spare engines available to lease to customers while their other CFM56 engine undergoes a shop visit. Typically, turnaround times on the CFM56 can be between 55 and 60 days, and smaller operators cannot afford to stop flying. Other large MROs have taken this approach, and Aero Norway has found distinct benefits for its business and the operator/customer. It enables Aero Norway to offer a more complete package."

Prolonging engine green time

By 2024, the oldest CFM56-7Bs will be over 26 years old. Still, fewer aircraft are retiring due to the surge in passenger numbers and a rebounding industry where aircraft and engine OEMs need help to keep pace with demand. Classic narrowbodies fly for longer, and popular engines such as the CFM56-5B and -7B

remain on-wing. Due to the reliability of these engines, few are being released for exchange or teardown, so the market for green time assets is highly competitive. Investors and operators can trust Aero Norway's experience as they seek a partner to help them steer through the complicated variables of the CFM56 aftermarket in what is likely to be a lengthy and uneven transition over the next decade.

Human resources

The final lynchpin of Aero Norway's ongoing change programme relates to human capital, and Russell is enthusiastic about his company's approach. "Investment in our people and processes is ultimately an investment in our future; there is a huge shortage of skilled labour across all MRO operations worldwide, and we predicted this would happen. Fortunately, we have developed a strong apprentice scheme programme, and this is now yielding value because we have fully trained engineers lined up and ready to work just as some of our older people retire.

"Home-grown skills are very important to Aero Norway as we direct some of our focus towards the induction of light worksopes for LEAP 1A and 1B engines at the end of 2024. We have no

plans to enlarge our global footprint; we intend to improve what we already have continually."

Aero Norway is also expanding its apprentice scheme with the Norwegian Government, and many more ambitious young people will join the current team of trainees as they move on to technical, sales, and customer support roles. This further reinforces Aero Norway's commitment to knowledge sharing and deepening the expertise and certification of its internal resource pool.

Burgeoning demand

In a buoyant CFM56 engine market, operators are looking for more shop visits for light engine repairs, and Aero Norway is adapting to this with greater flexibility on engine induction programmes. The business is streamlining processes and building skilled resources to ensure it can sustain its flexibility and commitment to fast turnaround times.

Aero Norway plans to remain a CFMI repair specialist, as this is where the organisation holds a depth of expertise and knowledge. With a heritage already spanning 30 years, the organisation is optimistic that burgeoning global operators and lesser demand for competitive and high-quality MRO support will see it at the forefront of delivering this service for decades. **AI**

“It has become clear that a new approach is required to compensate for the lack of combat air ‘mass’ and avoid the heavy losses that might otherwise result from trying to operate in a heavily contested A2AD environment”



A US Marine Corps XQ-58A Valkyrie conducting its second test flight at Elgin AFB, Florida, on February 23, 2023, accompanied by two USAF F-35A Lightning II aircraft assigned to 33rd Fighter Wing, 96th Test Wing
USAF/Master Sgt John McReil

When the idea of using an unmanned ‘loyal wingman’ to augment and complement manned fighters first emerged, these innovative platforms were seen as unmanned counterparts of the manned combat air platforms they intended to operate alongside, with much the same capabilities and performance characteristics. That concept seems to be evolving, with greater emphasis now being placed on smaller, cheaper and less capable ‘adjuncts’ and ‘effectors’. Even the term ‘loyal wingman’ has become problematic. Still widely used, describing

an autonomous unmanned aircraft “to be paired with and commanded by a crewed aircraft – particularly combat air,” the RAF’s recent Autonomous Collaborative Platform Strategy labeled it an “outdated term”.

The same strategy document prefers to concentrate on what the UK calls autonomous collaborative platforms (ACPs). These are “a series of uncrewed vehicles which demonstrate autonomous behaviour and can operate collaboratively with other assets.” These represent an additive capability that will enhance the effectiveness of the force mix.

The concept of replacing manned aircraft with unmanned platforms has existed for decades. Arguably, the 1957 Defence White Paper (the brainchild



Killer drones of tomorrow

*Will tomorrow's combat air platforms go to war accompanied by 'loyal wingman' drones, **Jon Lake** asks, or will they operate alongside simpler, cheaper 'adjuncts' and 'effectors' instead?*



of then-Defence Secretary Duncan Sandys) represented an early attempt to do so, albeit that the latter were missiles, not unmanned aerial vehicles (UAVs) or unmanned combat aerial vehicles (UCAVs).

For some years, it was assumed that the F-35 would be the “last manned fighter” and that manned combat aircraft would soon give way to unmanned combat air vehicles. Some still believe that we will eventually see unmanned platforms replacing manned combat aircraft, though this once-near-universal belief is now less widely held.

When the UK Ministry of Defence launched the Future Combat Air System (FCAS) in 2012 as a new four-year study, it was explicitly focused on future “unmanned combat air systems”. When FCAS transitioned to an Anglo-French survey in November 2014, it was similarly an unmanned aircraft programme based on previous work undertaken by the BAE Systems Taranis and Dassault nEUROn demonstrators.

But by the time the UK launched its new Combat Air Strategy in July 2018, the limitations of UCAV, sensor, and control technology and the need for a ‘man in the loop’ meant that the FCAS was now envisaged as a ‘System of Systems’. This system of systems would include manned combat aircraft alongside unmanned aircraft, long-range cruise missiles, large non-penetrating aircraft, air-launched unmanned air vehicles, and space-based sensors.

But while a manned fighter was to be at the heart of the FCAS system of systems and other sixth-generation combat air programmes, these programmes also included ‘high-end’ unmanned loyal wingmen that would augment rather than replace manned combat air platforms.

So, what has led to the rise of these new ‘robot warriors’?

Operation Desert Storm in 1991 provided an excellent exemplar of the West’s preferred way of waging war and served as a wake-up call to its adversaries. The West’s ability to project

decisive military power relied on the use of air power to achieve air dominance, conducting offensive and defensive counterair missions to remove the threat posed by an adversary’s fighters, surface-to-air missiles, and other air defence threats before dismantling the enemy’s fielded forces at leisure.

Realising this, Russia and particularly China focussed on uprating their air defences to prevent Western adversaries from practising this, their preferred way of war. Russia and China set about modernising their fighter and air defence forces, albeit Russia was more constrained by economic considerations. Nevertheless, Russia and China each launched next-generation fighter programmes, modernised existing fighter designs with new-generation radars and longer-range air to air missiles (AAMs) and developed sophisticated new surface-to-air missile systems and multi-spectral counter-stealth sensors.

This was a large-scale movement (by what are sometimes labelled as the revisionist powers) to counter the West’s air power strength with a greater mass of forces and by establishing a complicated operational environment that limited the West’s ability to sense and project credible combat power in contested areas of operation.

At almost the same time, Western politicians ignored this developing threat

and growing international instability and instead served up the ‘Peace Dividend’ they had promised. Military forces, including vital air superiority and air dominance capabilities, were cut back. The US reduced its fighter inventories, capped its acquisition of the stealthy F-22 air superiority fighter at just 187 aircraft, and delayed or cancelled a range of much-needed modernisation programmes.

By the time anyone noticed, China had created the world’s most sophisticated integrated aerial defence system (IADS) and established and matured an anti-access/area-denial (A2/AD) strategy that threatened to limit any offensive air operations against it severely. Although China has become the pacing challenge for sizing and shaping US military capabilities, Russia has not been far behind in modernising and improving its own air defence capabilities.

As a result, Western air forces now need more lethality, survivability, and capacity to achieve the degree of air superiority required to operate freely in an increasingly contested air environment or to guarantee victory against a rapidly evolving and dynamic threat.

It has even been calculated that in a representative ‘defence of Taiwan’ scenario in the next ten years, counterair requirements in the campaign could exceed the capacity of the USAF’s F-15C





CLOCKWISE FROM ABOVE:

Lockheed Martin's concept of a 'distributed team', with an F-35A and a range of unmanned adjuncts, ranging from the expendable to the exquisite
Lockheed Martin

The X-62A VISTA aircraft flying above Edwards AFB, California. The X-62A has played a pivotal role in the development of flying control software for autonomous platforms

Kyle Brasier/USAF

The first three F-16s for the VENOM programme arrived at Eglin AFB on April 1, 2024. The VENOM programme will allow the USAF to rapidly iterate potential autonomy solutions to get CCA flying as soon as possible

David Shelikoff/USAF

An F-15EX accompanied by a pair of MQ-28 Ghost Bats – the latter apparently operating in the 'classic' Loyal Wingman role, paired with and commanded by the manned platform

Boeing



and F-22 fleets by at least 50%. More broadly, it has been estimated that the USAF now lacks the numerical capacity and resilience that would enable it to conduct any extended combat operations in highly contested environments.

It has become clear that a new approach is required to compensate for the lack of combat air 'mass' and avoid the heavy losses that might otherwise result from trying to operate in a heavily contested A2AD environment. Unmanned platforms will play a vital role in this new approach, exploiting their lower cost, adaptability, and the evolving nature of technology to dramatically increase the pace at which new and emerging capabilities can be brought to bear. They promise to provide the freedom of access needed to operate within the most contested or degraded

battlespace environments, with distributed CCA (Collaborative Combat Aircraft) operations at scale being seen as the key to allowing the US to counter China's A2/AD capabilities in the Pacific theatre.

The rapid and dynamic development and iteration of new unmanned technologies have also been a feature of the ongoing war in Ukraine. This war has seen an unparalleled expansion in the use of low-cost, high-volume platforms, including first-person view (FPV) drones. It is already informing the development of new unmanned platforms and systems in the West. It significantly reinforces the need for a more rapid and agile iteration of new capabilities.

But while the war in Ukraine has been something of a proving ground for simpler, cheaper drones, the West, especially the USA, is looking at more advanced

unmanned capabilities.

The USAF Scientific Advisory Board envisages a range of CCAs operating in conjunction with other aircraft to employ “a distributed, mission-tailorable mix of sensors, weapons, and other mission equipment” in contested environments. The focus is on overwhelming an adversary’s air defences – operating these platforms against more sophisticated and challenging air and ground targets in a more complex environment and at a significantly greater range than current operations.

These CCAs are considered semi-autonomous, capable of taking high-level direction from a pilot and then autonomously implementing this direction. Such high-level direction might consist of a set of instructions along these lines (provided by an experienced UK fast jet pilot with experience in Harrier, Sea Harrier, and F/A-18): “Follow the ATO [air tasking order] outbound to the millimetre. Don’t run out of gas. Don’t transgress any known ACM [air combat manoeuvre]. Don’t penetrate a known MEZ [Missile Engagement Zone]. (I’ll tell you by text if there are any new ones). Don’t leave the FIR [Flight Information Region]. Don’t fly into me. Don’t get more than 20nm from me. Don’t employ without my say so. Please do if you’re near a POI [Point of Interest] and can capture an ISR product. If we lose comms for X minutes, return to CAP for Y minutes, then RTB [Return to Base]. Go home obeying the ATO

to the millimetre.”

There is broad agreement that ‘adjuncts’ to manned combat aircraft will need a degree of autonomy, as no one envisages the pilot of a Typhoon, F-35, Tempest or NGAD (Next Generation Air Dominance) operating their aircraft while simultaneously controlling a formation of UCAVs with a controller nor even giving them detailed instructions on a minute-by-minute basis! Instead, those unmanned adjuncts will follow pre-determined parameters to achieve their assigned missions, and the fast jet pilot won’t need to do very much at all. The adjuncts will be there (or, more likely, far ahead in the battlespace), giving them extra firepower at a greater range and providing greater sensor coverage. (Adjuncts are defined as uncrewed aircraft systems specifically designed to work in conjunction with other aircraft or effectors to add to the effectiveness of the force mix.)

In the long term, Western air forces plan to use these unmanned adjuncts to augment new sixth-generation manned fighters (and even new bombers like the B-21 Raider).



Still, some may be pressed into service in the near-to-medium term, operating in conjunction with today’s combat air platforms to disrupt and defeat enemy counterair operations, bringing more weapons to the fight, and ‘standing in’ in the most contested areas, where an allied air commander might be reluctant to risk his manned assets.

Initially, much attention was focused on what we would now term the ‘classic’ loyal wingman – autonomous unmanned fighter aircraft able to operate alongside and ahead of manned fighters, enjoying the same endurance, range, and performance characteristics, and with their sensors and weapons, but ‘tethered’ to manned platforms in a relatively rigid fashion.

The problem with such a vehicle is that this degree of performance and capability will cost half as much as a manned fighter, making the ‘loyal wingman’ too valuable to be much more attritable than the manned formation leader. And while manufacturing technologies and autonomy will evolve and improve, and although the cost of high-end systems (which currently compare to the prices of more capable manned aircraft) will probably fall, they are unlikely to fall far enough to make these most capable CCAs attritable in any meaningful way.

In March 2019, as the Kratos XQ-58 Valkyrie made its first test flight at Yuma





CLOCKWISE FROM ABOVE:

Britain terminated the Mosquito programme in June 2022, in favour of smaller, less costly, but still highly capable additive capabilities which had “specific uses cases.” The Spirit Aerosystems air vehicle may have also raised concerns due to its US and ITAR concerns, without the prospect of a USAF order
MOD/Crown Copyright

Boeing MQ-25s will replace the F/A-18 Super Hornets, which have been reassigned from combat duty to act as ad hoc tankers, in the US Navy’s role of refuelling fighter aircraft at sea
Boeing

The twin-engined Pizzookie uncrewed aircraft system was developed rapidly in conjunction with startup Intrepid Minds, and used additive manufacturing
RAF Rapid Capabilities Office

Six Callen Lenz Koios VTOL UAVs with an RAF Chinook during crewed-uncrewed (CUC-T) trials. The Koios UAV has removable wings and tail, allowing it to be rapidly deployed or disassembled and transported in two packing boxes. Once unpacked, it can be launched in less than ten minutes, making it a versatile asset for time-sensitive missions
MOD/Crown Copyright

The RAF’s new Autonomous Collaborative Platform Strategy document outlines the UK’s plans for adjuncts within its FCAS family of systems. The aircraft on the cover is a Tekever AR3. Though Tekever is a Portuguese company, it has a contract with the UK Home Office and is being supplied to Ukraine by the UK
MOD/Crown Copyright



Proving Ground, Will Roper, assistant secretary of the Air Force for acquisition, technology and logistics, outlined a requirement for a loyal wingman that could “perform and manoeuvre like a fighter jet”, flying at high subsonic speeds, taking off without a runway, and that could meet or exceed the Air Force’s requirement for a 1,500nm range carrying a 500lb payload. Roper predicted that these aircraft would cost “a couple of million bucks” each when produced in volume. The XQ-58A was initially developed under the LCAAT (Low Cost Attributable Aircraft Technologies) programme. Still, its creator, Kratos, has not been down-selected for the CCA programme, perhaps indicating that the USAF is looking for a more complex and exquisite solution. (Exquisite systems have been defined as those “for which the cost

or capability is considered of such value to the force that loss would likely cause mission failure.”)

By 2023, Air Force Secretary Frank Kendall predicted a cost of roughly one-quarter to one-third of the cost of an F-35 (e.g., \$20-27 million). Many believe that even this is a significant underestimate. However, Australia hopes to get the price of the Block II MQ-28 down to “10% of the price of an F-35A,” according to Pat Conroy, Australian minister for Defence Industry.

Powerful forces are lobbying for CCAs, not least those companies that hope to sell their products to the US Department of Defense (DoD). Some believe there is an element of the ‘emperor’s new clothes’ syndrome, with industry telling the DoD what it needs to generate more sales without adequately evaluating the latest systems’ actual military utility and practicality. ➔



LEFT FROM TOP:

QinetiQ's Jackdaw platform will be modular and, as such, is designed to support 30kg of internal payload while achieving over three hours of endurance in theatre, reaching 400kts and altitudes of 30,000ft
QinetiQ

The Jackdaw is intended to be reusable but is cheap enough to be expendable if required. It is capable of a number of uses. Four are seen in this image, supporting an F-35 by acting as decoys and jammers
QinetiQ

BAE's latest autonomous collaborative platform (ACP) was revealed at the recent World Defence Show in Saudi Arabia. It employs a novel low-observable configuration
BAE Systems



There are already some signs of a move away from this most expensive class of UCAV, and some CCAs may be significantly less expensive than crewed aircraft, allowing them to be used as expendable or attritable assets. Attritable may describe a system intended to operate and be recovered over several missions. However, loss or attrition is acceptable when mission requirements dictate and/or if it contributes sufficiently to achieving a tactical or strategic objective. Attritable systems are not expendable or throwaway, as Kendall explained: "They're intended to be systems that you can accept losses of a fraction of them and not have a big operational impact." In some air forces, the term 'risk tolerant system' is preferred. The US Air Force has shifted away from the term attritable when discussing CCAs, preferring the term 'affordable mass'.

The Boeing MQ-25 Stingray shows a shift away from the traditional loyal wingman. This has evolved from the original (2010) Unmanned Carrier-Launched Airborne Surveillance and Strike aircraft, carrying an AESA radar and AIM-120 AMRAAMs, to become a much simpler Carrier-Based Air Refuelling System (CBARS) also capable of "a little ISR". However, its original vision of serving as a robotic wingman for the F/A-18 and F-35C had been abandoned by 2016.

When Lockheed's John Clark, general



manager and vice president of the Skunk Works, laid out his vision of the future of combat air in July 2022, it was centred on a 'distributed team' of diverse unmanned aircraft working in concert with manned types. It lacked a traditional loyal wingman concept. Instead, company concept artwork showed a range of different pilotless platforms, extending from lower-end expendable and 'attritable' designs to more 'exquisite' types, all working in complementary ways with existing and future manned combat aircraft and with each other, leveraging novel and

future uncrewed Combat Aircraft Technology Demonstration (for a loyal wingman aircraft known as LANCA – the Lightweight Affordable Novel Combat Aircraft) to a premature close in June 2022, instead launching what Air Commodore Jez Holmes, Head of the RAF's Rapid Capabilities Office described as "activities to aggressively pursue the RAF's unchanged firm commitment to integrate advanced uncrewed capabilities into the near-term force mix with more immediate beneficial value." Parallel analysis and capability experimentation



ABOVE:
BAE Systems' single-engined concept is comparable in size to the Hawk advanced jet trainer. The ACP demonstrator is expected to fly within the next two years
BAE Systems

distributed architecture. The company's concept placed more emphasis on lower-end expendable vehicles like the 'Speed Racer' (Small Penetrating Expendable Decoy Radically Affordable Compact Extended Range) and the low-cost, missile-like customisable Common Multi-Mission Truck (CMMT) through to the attritable Tactical Expendable-Combat Air Vehicle (capable of operating as a remote weapons station), and more exquisite, survivable UCAVs.

The UK brought its Project Mosquito

conducted by the RAF and the Defence Science and Technology Laboratory (DSTL) concluded that more beneficial capability and cost-effectiveness might be achievable by exploiting smaller, less costly, but still competent additive capabilities with "specific use cases".

While there is wide agreement that tomorrow's combat air platforms will operate as part of a system of systems with unmanned adjuncts and effectors, there is much less agreement as to what these adjuncts and effectors should





be. In the US, the USAF is still looking at 'higher end' options with significantly higher than originally expected performance and payload capabilities. However, the USAF is still in the early stages of defining key CCA requirements and estimating costs.

At the 2023 Air and Space Forces Association's Warfare Symposium, Major General R Scott Jobe, the Air Combat Command Director of Plans, Programs, and Requirements and Brigadier General Dale White, the Air Force's Program Executive Officer for Fighters and Advanced Aircraft, outlined a new strategy of 'affordable mass'. They shifted away from using the term attritable (a system characteristic that trades reliability and maintainability for low-cost of a system meant for reuse) and fought the Senate's attempts to impose hard cost targets for different tiers of CCAs in the NDAA (National Defense Authorization Act), which specifies the budget, expenditures and policies of the DoD. The Senate had wanted to create general cost categories for CCAs, with a US\$3m limit for 'expendable' aircraft, \$10m for attritable, and \$25 million for exquisite CCAs.

In the UK, there is at least a definition of classes of Autonomous Collaborative Platforms (or ACPs, as the UK likes to call what the USAF terms CCAs), thanks to the Air Capability Strategy and the RAF Autonomous Collaborative Platform Strategy, as well as some subsequent clarification by Sir Richard Knighton,

the Chief of the Air Staff, during his recent appearance before the House of Commons Defence Committee.

Tier 1 ACPs are small, single-use or disposable ACPs capable of various tasks, with a life cycle of one (or in some definitions) very few missions. There is also a 'Distinct Tier 1' category, describing small single-use ACPs that are designed for one bespoke role. Knighton said: "Tier 1 is small, much cheaper, probably several orders of magnitude cheaper than a crewed platform capability – we are talking hundreds of thousands of pounds; we judge those to be completely

disposable, and we would not expect them to come back from a mission."

There is some potential for confusion here since the same 'Tier 1' designation covers single-use, disposable, and sacrificial systems intended to be used once and not recovered, but it also covers recoverable, reusable systems with a very short operational life.

Tier 2 ACPs are larger, attritable ACPs capable of multi-role employment, expected to survive the mission, but losses of which are deemed acceptable. They are attritable or risk-tolerant systems that have been assessed on a risk-to-benefits





CLOCKWISE FROM ABOVE:
BAE's attritable platform would feature so-called goal-based autonomy, relying on the integration of artificial intelligence. Roles could include intelligence, surveillance and reconnaissance and electronic attack
 BAE Systems

After a rapid and agile design and build that took two and a half years from the contract award, the XQ-58A Valkyrie completed its first flight on March 5, 2019. On January 23, 2020, the aircraft completed its fourth flight, meeting all of the flight's test objectives
 USAF/AFRL

The Air Force Research Laboratory's XQ-67A Off Board Sensing Station is the latest US CCA to emerge, making its maiden flight on February 28 from Gray Butte Field Airport, Palmdale, California. The XQ-67A is a single-role, relatively inexpensive vehicle
 General Atomics ASI

One likely application for more complex, more exquisite CCAs will be High-Value Airborne Asset Protection – arguably one of the less demanding air-to-air combat roles. Four MQ-28s are seen here escorting an E-7A Wedgetail. In reality, the MQ-28 lacks the performance required for this mission
 Boeing

framework and found not to impose high replacement costs or to impose a critical risk of degradation/loss within its family of systems. "Tier 2 is described as attritable, so we would expect them to come back sometimes. We could tolerate losses, but clearly, as it gets more expensive, the economics of that model shift," Knighton explained. A Distinct Tier 2 category also describes similar systems designed for one primary role.

Tier 3 is defined as a survivable "ACP

of strategic value whose loss would be unacceptable... an exquisite system designed to operate and be recovered on a similar level to crewed assets. Attrition would not normally be expected or acceptable except in prosecuting the highest value mission sets." Knighton described Tier 3 as applying to "platforms that we would expect to be completely survivable. We would want them to come back all at the same time."

Even in the US, there are conflicting





signals. While some elements within the USAF are still pressing to adopt more exquisite CCAs, others are retreating from them. In July 2022, Air Force Secretary Frank Kendall announced the scrapping of plans to develop an unmanned counterpart of the B-21 Raider stealth bomber. "The idea of a similar range collaborative combat aircraft is not turning out to be cost-effective, so it looks like we're not going to go that direction," he said.

Much will depend on ongoing experiments and technology demonstrations. These include DARPA's Air Combat Evolution (ACE) program, which sought to automate air-to-air combat and which saw a Heron Systems' F-16 AI agent beat other AI programmes performing simulated, within-visual-range air combat manoeuvring before winning a series of simulated dogfights against an experienced Air Force F-16 pilot 5-0 in the AlphaDogfight Trials Final event! This demonstrated that an AI agent could quickly and effectively learn basic fighter manoeuvres and successfully employ them in a simulated dogfight.

The Lockheed Martin VISTA X-62A has had an integral role in the rapid development of AI and autonomy capabilities for the USAF, exploiting its open systems architecture and advanced VISTA (Variable In-flight Simulation Test Aircraft) flight control system to conduct the most advanced flight test experiments of autonomous software and AI algorithms, including being flown by an artificial intelligence agent for more than 17 hours in December 2022. The aircraft allows quick software changes, giving a real rapid prototyping advantage. This has permitted autonomy for uncrewed platforms to be rapidly matured.

VISTA is a modified F-16D Block 30 Peace Marble II aircraft upgraded with Block 40 avionics and an all-new flight control system provided by Calspan. Previously designated as the NF-16D or VISTA F-16, the aircraft was redesignated as the VISTA X-62A in June 2021.

Building on the work carried out

using VISTA; the USAF is modifying six F-16 aircraft into test platforms to test autonomous software and rapidly evaluate autonomous capabilities under the Viper Experimentation and Next-gen Operations Model—Autonomy Flying Testbed (VENOM-AFT) programme.



The project is intended to inform the Collaborative Combat Aircraft programme, fostering novel autonomous functions for current and future crewed and uncrewed platforms. VENOM-AFT is initially expected to leverage aircraft-agnostic autonomous flight software developed under the Air Force Research Laboratory-led Skyborg programme.

The VENOM programme is intended to enable the Air Force to rapidly iterate and expand the body of knowledge for potential autonomy solutions. It will be focused on 'speed-to-ramp', progressing as fast as is safely possible to get CCA flying as soon as possible.

The modified F-16s will be flown by developmental test and operational test pilots from the 40th Flight Test Squadron and the 85th Test and Evaluation

Squadron (part of the 96th Test Wing and 53rd Wing at Eglin AFB) working and flying from the same location. The human pilot will fly the aircraft to the test airspace and then oversee and monitor the aircraft's autonomous operation within the designated airspace. The human operators will then provide feedback to the developers during modelling, simulation, and post-flight. There will never be a time that the VENOM aircraft will fly solely without a 'human in the loop' who will be able to start and stop specific algorithms.

The first three F-16 Fighting Falcons for VENOM-AFT arrived at Eglin on April 1, 2024, where the 96th Test Wing and the 53rd Wing welcomed them. But while the VENOM-AFT programme is using F-16s as testbeds, it is not focused on high-end, Tier 3 exquisite CCAs but on all classes of CCA, including the expendable and attritable aircraft, which now seem most likely to be fielded first.

Earlier this year, the Mitchell Institute for Aerospace Studies in Arlington, Virginia, published a key report on CCAs, which

seemed to highlight the critical importance of 'lower end' expendable and attritable systems operating collaboratively with fifth-generation and sixth-generation combat aircraft as force multipliers, disrupting and imposing costs on a peer or near-peer adversary's air defences. During a set of wargames organised by the institute, all three wargame teams chose to use a mix of CCA variants operating as airborne sensors, decoys, jammers, or weapons launchers to disrupt and stimulate the PLA's IADS, locate its critical nodes, and begin to attrit threats to support operations by crewed aircraft. None of the teams opted to use the most sophisticated, highest-performance class of CCA.

Operational analysis has indicated that CCAs and ACPs could fulfil multiple mission sets, including forming a self-

A furious opening gambit for the USAF's CCA project

On April 24, a significant development unfolded as the US Air Force, after careful consideration, announced its selection of Anduril and General Atomics from a pool of five competitors for funding. This decision paves the way for the continued development of their autonomous UAV concepts, a crucial step towards meeting the USAF's Collaborative Combat Aircraft requirement's 'Increment 1'.

While Anduril and General Atomics have secured the funding, it's important to note that the 'losing' bidders (Boeing, Lockheed Martin, and Northrop Grumman) are not out of the game. They will remain part of the broader industry partner vendor pool, retaining the opportunity to compete for future production contracts. This ensures a dynamic and competitive landscape in the industry.

The choice of Anduril and General Atomics is interesting, and some believe it reinforces the preference for 'lower end' attritable rather than exquisite CCAs, marking a further retreat from traditional 'Loyal Wingmen'. The General Atomics Gambit family includes the XQ-67 Off-Board Sensing Station. At the same time, the Anduril



Fury was developed from the Blue Force Technologies Grackle (later REDmedium, and finally Fury), which was initially designed for Adversary Air training.

However, drawing definitive conclusions would be premature as there will be further CCA increments for various CCA classes.

OPPOSITE FROM TOP:

The General Atomics Gambit is a family of modular drones, seen here operating as remote weapons carriers with a pair of larger MQ-28s and launching air-to-air missiles against enemy air platforms

General Atomics

Project Carrera is a US\$100 million Lockheed Martin investment in distributed teaming. Here, and F-35 is seen with a SPEED RACER modular uncrewed aircraft, one of which acts as a decoy

Lockheed Martin

healing mass sensor network or data and communications rebroadcast networks that move information into and out of threat envelopes. CCAs can also perform 'up threat' targeting and attack, SEAD (suppression of enemy air defenses) and stand-in jamming, or act as decoys.

Some unmanned aircraft (like the US Defense Advanced Research Projects Agency's Longshot) could be 'remote carriers', bringing more weapons to the fight and perhaps deploying them further forward than manned aircraft. More complex CCA/ACPs could carry out High-Value Air Asset (HVAA) protection and even some lift/mobility tasks.

Dispersing different functions (such as sensing, jamming, decoying, and delivering effect) across various cheaper single-role CCAs is the best way to ensure operational resilience and overwhelm an enemy by increasing the number of airborne targets it must deal with. An adversary cannot differentiate between how CCAs are equipped and roled at any particular time and must, therefore, regard all of them as threats.

Moving away from the traditional 'loyal wingman' means that the speed and range performance of a CCA/ACP no longer needs to be tied to that of the lead manned aircraft since it will not accompany that manned platform throughout the duration of a mission. Instead, performance can be optimised for the task at hand, and the CCA/ACP may be forward-based (truck launched from an island base, perhaps, since CCA/ACPs may be able to operate away from traditional basing infrastructure and runways) or launched from a large

manned aircraft. This increases the number of potential basing sites and provides allied commanders with variable, flexible options while complicating the enemy's targeting problems. It may also make the CCA/ACP smaller and cheaper. The CCA/ACP will operate independently of – but in co-ordination with – other elements of a strike mission.

The smaller, cheaper CCAs/ACPs may also require a more limited degree of autonomy, with just enough algorithmic ability to target independently (and perhaps to perform air combat) rather than 'full AI'.

This could be a critical factor due to the growing ethical objections to higher autonomy and technical challenges. At the time of writing, the only unmanned aircraft likely to be able to operate in unsegregated airspace is the GA-ASI Certifiable Predator B (known as the Protector RG.Mk 1 in UK service), but then only when equipped with a suitable detect and avoid system. The Protector is a remotely piloted aircraft system, not an autonomous drone, which would be much harder to certify to similar standards.

Add in machine learning or the use of deep neural networks (as opposed to simpler algorithmic AI), and the problems will become more complex. This may constrain the further development of CCAs/ACPs (at least in the near term), especially the more complicated and sophisticated variants. But while there may be difficulties to overcome, the promise offered by CCAs/ACPs is such that these seem certain to be overcome, and they seem certain to be an essential part of future air operations. **AI**

'We've got it, and it's on the way'



A few companies ooze confidence and self-assurance when you visit: from well-kept lawns outside its headquarters at Slinfold, West Sussex, to the efficient operation of its warehouse – with an endless stream of aircraft parts packed, labelled, loaded and sent on their way, AJW Group is justifiably a global MRO sector leader. **Glenn Sands** spoke to some of its key players

Time is money', and nowhere is this more apparent than in aviation, with aircraft, airlines and operators all needing to be at a destination on time, every time. While the end product for many is seeing the shiny white airliner at the airport as

they make their way along the walkway to board, few are aware of the many components, parts, repair and supply chain companies providing support to ensure this aircraft operates perfectly.

These companies, often operating in the background, are the backbone of the aviation industry, building their reputation on their ability to respond to the airline's

request for a specific part and deliver it to the other side of the world in the shortest time possible. Their 24-7 dedication to precision and efficiency keeps the aviation industry soaring, and they are not resting on their laurels. Instead, they are embracing new technology, constantly striving to improve and lead the way into the future of aviation.



MAIN IMAGE:
The impressive headquarters of AJW Group, located in Slinford, West Sussex, reflects the professionalism and attention to detail that operates at every level within the company
All Images AJW Group

INSET: *Christopher Whiteside, chairman of the AJW Group, a lifelong aviation business professional and entrepreneur*



It's a concept long held by Christopher Whiteside, chairman of the AJW Group. This independent, award-winning MRO company has earned itself a reputation as one of the sector's most trusted and efficient operators, supporting more than 1,000 airlines across 100 countries.

At the core of the company is the belief in establishing a mutually beneficial, trusted partnership with the client. It's a point Whiteside is keen to emphasise: "We have an exceptional reputation in the industry and strive to do our job consistently, practically, reliably and honestly to best serve our global customers best."

He added: "We are continually investing and developing our services, from adding additional capabilities at our MRO facilities in Montréal and West Sussex, forming partnerships with OEMs to drive cost and service efficiencies, and investing in the latest aircraft assets to maintain our reputation for customer service excellence."

"We recently announced the acquisition of a Boeing 787-9 Dreamliner and have entered the Airbus A350 support market by acquiring a significant spare parts package. These are strategic moves, and



we are now positioned to support A350 operators and airlines worldwide with many components."

This ability to respond quickly to the sector's needs indicates that Whiteside keenly monitors the operators' future needs. AJW has strategically positioned Airbus A350 spare parts in its various

hubs across Europe and the Americas. "We are poised to provide unparalleled service for the new generation of long-haul aircraft, ensuring efficient maintenance operations across our existing and expanding global A350 customer base with the added support of AJW Technique, our MRO facility in





CLOCKWISE FROM LEFT:

The main warehouse at Slinford, West Sussex

Scott Symington, chief commercial officer drives the AJW Group's sales plan and commercial strategy

Escape slides at AJW Technique's Montreal site

Clyde Buntrock, chief executive officer AJW Aviation and AJW Technique



Montréal," said Whiteside.

Investing in its customers' current and future needs has been a cornerstone of AJW's operations. Only by acquiring the latest generation of aircraft will its access to the more significant market demand align with its inventory, which is shifting ever more to modern technology standards.

This constant upgrading has allowed digital technology to become a core strategy within the AJW Group, which has proven to benefit the business and customer, according to Whiteside: "Integrating and embedding digital solutions into our processes, from the outset, has helped drive transformation through innovation while reflecting industry trends sooner."

Focusing on people

The AJW Group has attracted the best and the brightest to join its staff, and all come with a wealth of knowledge and experience that they are keen to develop within the Group across all its divisions. Clyde Buntrock, chief executive officer of AJW Aviation and AJW Technique, joined the company in 2022, having had experience in global supply chain

management and technology. It's that experience that he believes has proven invaluable in his current position, which he admits has provided plenty of challenges and opportunities within the sector. But he is also very much focused on AJW's staff, too.

He said: "My style is to have a relentless focus on people and building high-performing teams, and my success stems not only from my business background, but from my passion for sports. In today's dynamic business environment, I have translated this focus to fostering a positive performance culture that isn't just a strategic move, it's a necessity.

"I firmly believe that our people are the cornerstone of our success, and interpersonal relationships are the bedrock upon which success is built. By nurturing a culture of positivity and continuous improvement, we foster excellence, which, in turn, builds trust and respect. This culture enhances productivity and engagement and contributes to well-being and staff retention."

Continued development of those on the 'shop floor' and the opportunity to create

'high-performance teams' through training have created a robust performance culture across all areas of the Group. Buntrock is keen to point out that "clear communication, trust and collaboration" are areas he looks at every workday and promotes.

The experience that executives bring to AJW has already positively impacted the business's success. After COVID-19, many MRO companies were left struggling and waiting for the commercial aviation demand to return to pre-pandemic levels. Only by having a trained, efficient workforce able to respond when the inevitable surge in demand returned, has kept AJW ahead of its competitors.

Buntrock explained: "By conducting regular performance development reviews we ensure we align individual goals to our strategic business goals. We work on goals from top to bottom, fostering accountability and driving performance. Regular check-ins, clear expectations and peer-to-peer accountability empower our employees to excel, contribute meaningfully to our collective goals and promote our company values.

"Transparency, honesty and open communication channels are





CLOCKWISE FROM ABOVE:
Louis Mallette, president of AJW Technique

Attention to detail and second-to-none organisation are hallmarks of the AJW Group. The facility in Montreal reflects this

AJW Technique facility, Montreal, Canada

fundamental to our leadership approach as these principles lay the foundation for long-term growth. We provide ample training opportunities for our people that promote idea generation, knowledge sharing and strategic alignment, fostering a sense of purpose and belonging among our employees to promote a positive company culture.”

An eye on the future

No matter how good the team, the aviation industry experiences fluctuations, and the global pandemic demonstrated that it has to be adaptable – a view echoed across the Group that has kept the company within a leading position in the MRO sector.

Scott Symington, chief commercial officer, keeps a firm eye on the future of AJW to ensure any challenges can be met: “The industry has recently experienced a trend in aircraft retention. Faced with delays associated with new-generation platforms like the NEO and the MAX, coupled with the surge in demand post-COVID, operators are holding on to their fleets longer than ever before.

“This prolonged operation necessitates extensive maintenance, presenting

challenges and opportunities for the industry. As a company, we noted the implications of this trend and proactively adjusted our strategies to meet our customers’ needs.

“Central to our approach is the seamless integration of digital solutions into our operations. We’ve streamlined processes through digitisation efforts, enhanced inventory management, and provided real-time visibility into component status and shipment tracking. We are developing automated fulfilment solutions and looking at our first pilot for robotics in our MRO facility in Montréal. These advancements will allow us to respond rapidly to customer needs and optimise our inventory levels and market demand efficiently,” said Symington.

Global teams

For any MRO company, managing inventory is a balancing act that requires understanding of patterns and lead times. Symington continued: “We employ priority forecasting and data-driven decision-making to maintain optimal inventory levels while minimising surplus stock holdings. Our procurement strategies encompass diverse channels, each with



risk and reward profiles.” The company strives to balance maximising returns and minimising risk exposure, as is the case with all MRO sectors.

However, having a large inventory is not good enough if it’s all in one location, effectively increasing delivery times and logistics when the request comes in. It’s an issue Symington is keenly aware of: “A large part of inventory strategy involves strategically placing inventory across our global hubs and having well-placed global teams to service our customers in various regions. Over the past couple of years, AJW has expanded its global operations by placing support teams in Turkey and Mexico City to underscore our commitment to offering an international and customer-centric service.

“With additional support from AJW Technique, our MRO facility in North America along with our strategically located global offices and hubs have delivered unparalleled service, priming us to capitalise on emerging regional opportunities.”

But Symington also has eyes on the future, particularly the emerging eVTOL market, which the Group is keen to enter: “We’re embracing innovation and driving

positive change in the industry through our recent partnership with Lilium, a market leader in eVTOL technology. By serving as the exclusive parts distributor for Lilium’s eVTOL jets, we’re supporting ground-breaking technology and championing sustainability within aviation.

“Our strategic alliance with Lilium underscores our belief in the power of collaboration to shape the future of aviation. Together, we’re establishing

efficient material services and distribution channels to ensure the seamless operation of these cutting-edge aircraft worldwide while sharing a commitment to reducing carbon emissions and mitigating the environmental impact that paves the way for a more sustainable aviation industry.”

Strategic advantage

Montréal, Canada, is regarded as a critical aerospace hub within the industry and is home to the MRO facility for AJW Technique, which provides an invaluable strategic advantage. It serves as a melting pot of talent and expertise, facilitating collaboration and innovation within the industry. Proximity to other aerospace OEMs allows the Group to stay ahead of the curve, enabling AJW Technique to meet the needs of an ever-evolving market.

AJW Technique Europe, based in West Sussex, UK, specialises in aircraft battery maintenance, boasting a Centre of Excellence dedicated to this critical aspect of aviation. President of AJW Technique, Louis Mallette, believes his ability to speak English, French and Spanish has helped him navigate different cultures and led to success in his role. “Our work here is not without its challenges and opportunities. The resurgence of global passenger traffic over the past two years presents both, particularly regarding our MRO operations.

“Labour shortages continue to be a concern, threatening to impede the anticipated growth in flight schedules and fleet expansion. We’ve recognised the importance of investing in talent development initiatives to address this head-on,” said Mallette.

He also echoed the concerns of Symington: “The industry is seeing the prolonged operation of older aircraft, coupled with supply chain disruptions, underscoring the critical role of component repair activities. At AJW Technique, we anticipate a surge



RIGHT:
Solar panels on AJW's headquarters in Slinford

BELOW:
Barry Swift, chief operational officer, is focused on the strategic improvement of AJW's logistics and warehousing capability



in repair demand and are committed to operating at maximum capacity to support the growing fleet. By investing in inventory and strategically placing this across our global hubs, we already have proactive measures to mitigate supply chain disruptions and ensure uninterrupted MRO operations.”

Robust growth

With the need to constantly focus on the future, Barry Swift, the chief operational officer, is best placed to comment on how AJW will move forward: “From my perspective, the future for the company is about managing high growth, becoming even more effective and driving further efficiency. We are planning significant growth with an ‘if you build it, they will come’ mentality. It’s about growth at pace, founded on robust and resilient operational capabilities.

“Logistics connectivity and effectiveness are an ever-increasing aspect of MRO, having increased exponentially since COVID-19. Challenges around material availability and lead times drive the need for faster logistics activity.

“AJW recently completed the largest and most comprehensive logistics tender in its history. The tender was, in effect,

a clean-sheet exercise, during which we reviewed all our logistics requirements as if the company were a new start-up.”

Swift added: “This thorough review revealed that while approximately 60% of our existing logistics processes were solid, they required significant refinement and modernisation, including tighter contractual agreements and the adoption of further digital tools for enhanced efficiency.”

AJW has partnered with a new supply chain solutions team to improve logistics, regarded as a strategic step towards consolidating the company’s supply chain management under a digital framework. Swift said: “The tender shed light on the need to reassess certain logistics suppliers that lacked agility or sufficient digital capabilities to meet and manage the Group’s evolving needs and future growth.

“Over the next two years, AJW will introduce a comprehensive digital initiative to boost its logistics capacity by more than 50%. A vital component of this initiative involves the conceptualisation of automated warehouse implementation, a project slated to triple our warehouse capacity within the same timeframe.”

This transformative approach addresses immediate logistical challenges and positions AJW for sustained growth and operational excellence in the future. It’s clear that Swift has a lot on his hands over the next two years, but he remains optimistic about the results: “AJW’s transformation journey is pivotal for our success in today’s dynamic aviation and business environment. By proactively reassessing and revamping our logistics operations, we exemplify the power of adaptation and innovation in staying ahead of the curve.

“The process enables us to address the current challenges effectively and anticipate and prepare for future ones. Moreover, embracing digitalisation and automation enhances our operational efficiency and fosters agility, scalability and resilience – all crucial factors for the Group’s sustained competitiveness – unlocking new avenues of growth and continuing our mission to transform aviation efficiency,” said Swift.

A greener planet

The AJW Group firmly focused on the future of aviation, it’s also aware of the industry’s impact on the environment and the drive to introduce sustainability alongside growth.

The Group has already introduced several practices, as Buntrock explained: “From sourcing eco-friendly materials to adopting sustainable practices in our MRO facilities, we’re committed to minimising our environmental footprint. Whether opting for environmentally friendly cleaning solutions or exploring innovations in materials, sustainability permeates every aspect of our operations.

“We’ve implemented rainwater harvesting systems and solar panels at our eco-friendly headquarters. Our Facilities and Operation teams are spearheading initiatives to reduce our CO₂ emissions further, demonstrating our unwavering dedication to environmental awareness.

“The proactive involvement of our global teams underscores our ongoing commitment to a greener planet and positions us as a leader in fostering business sustainability within the aviation sector.”

Mallette supports Buntrock’s comments on greater sustainability. He added: “Sustainability lies at the heart of our business ethos. Central to our sustainability efforts are economical repair activities and responsible end-of-life management. Through repair and recycling processes at all our facilities, we minimise environmental impact while delivering cost-effective solutions to our customers. This commitment aligns with regulatory requirements and enhances our corporate social responsibility profile, positioning us as a preferred MRO partner within the industry.”

AJW Group has a clear path to follow in supporting commercial aviation in all its sectors. A comment from Whiteside best summed up its future: “We’ve come a long way. We have strong foundations and ambitions that will keep us progressing for decades to come.” **AI**

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A torrid time

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The Lockheed Martin F-35 is currently at the cutting edge of modern combat aircraft, but upgrading the airframe may not be as easy as once stated, as **Jon Lake** discovered



When we spoke to Leonardo VP Jonathan Smith in the February 2024 issue of *Air International*, we were surprised to learn that he believed the F-35 would be “significantly challenged” in the future, in part because it will not be possible to upgrade and iterate it to the required standard. That the F-35 is difficult to upgrade has been borne out by recent events, not least the testimony of USAF Lt Gen Mike Schmidt, programme lead of the F-35 Joint Program Office (JPO), before the US House Armed Services Tactical Air and Land Forces subcommittee on April 16.

Schmidt admitted he was “getting tired of over-promising and under-delivering” as he outlined ongoing problems with the

planned Block 4 suite of upgrades and the Technology Refresh 3 (TR-3). This is intended to provide the extra computing power needed for Block 4 improvements to sensors and weapons, modernising the computational core of the F-35 air vehicle and adding updated panoramic cockpit displays, a new L3Harris integrated core processor and a revised aircraft memory with more capacity.

Block 4 initially consisted of some 53 improvements to counter emerging Chinese and Russian air- and ground-based threats. These were expected to involve fresh or enhanced software features and new weapons integrations, initially planned to be rolled out via staged updates every April and October starting in 2019 and continuing until at least 2024, although these dates soon slipped.

Much of the delay to Block 4 has resulted from technical issues with



ABOVE: The 461st FLTS has expanded to include six TR-3 test aircraft alongside a similar number of aircraft in the original TR-2 configuration. This allows the unit to make direct comparisons of four-ship operations by both types USAF

OPPOSITE: F-35 Joint Program Executive Officer (PEO) Lt Gen Michael Schmidt at the production line at Lockheed Martin's Air Force Plant 4 in Fort Worth, Texas, on November 3, 2022. This was Schmidt's first visit to the facility following his appointment as F-35 PEO. The F-35 Joint Program Office is the Department of Defense's focal point for the aircraft USN/Chief Mass Communication Specialist Matthew Olay

the TR-3 programme, which mean the upgrade is running three years behind schedule. According to the US Government Accountability Office, this has accounted for a \$330 million increase in the F-35's development costs. This is partly due to the failure of the C2D2 (Continuous Capability Development and Delivery) methodology adopted by Lockheed and the JPO, which was supposed to see half-yearly software updates (software builds), each with four capability increments adding new functionality. This was not rigidly adhered to and the June 2020 build had ten increments, four of which addressed software defects. TR-3 itself experienced "technical complexity challenges" with hardware and software.

Despite these setbacks, Major Ryan 'Bolo' Luersen from the 461st Flight Test Squadron conducted the first flight

of an F-35 in the Technology Refresh 3 (TR-3) configuration on January 6 at Edwards Air Force Base, California. The jet used was AF-7, 07-0745, a specially instrumented flight test aircraft. The 'Deadly Jesters' of the 461st Flight Test Squadron is the Department of Defense's lead developmental flight test unit for the sensors, weapons and software on all three variants of the F-35 and it received six brand-new F-35As to test the Technical Refresh 3 and Block 4 configurations from August 2022 (the first, 20-5778, arrived on August 1). This was necessary because the complex test missions flown required a four-ship of instrumented test F-35s to evaluate the aircraft's warfighting systems fully and – ironically – to ensure that the new configurations were combat-ready from the outset.

Unfortunately, flight testing revealed

a disparity between software stability on the ground, on the rig in Lockheed Martin's laboratories and when operated on the F-35 flight test aircraft. A frustrated Mike Schmidt said: "I wish I had all of the solutions in place that prove to me that when I do something in the lab, it's going to show up that way in the air."

Deliveries planned for July 2023 were pushed back to April-June 2024. The first production F-35 in an early version of the Tech Refresh 3 configuration had flown during the week commencing November 13, 2023, at Fort Worth, but it could not be delivered. Lot 15 F-35s were built with TR-3 embedded, but the customer refused delivery of aircraft built to this standard, and, from July 2023, new aircraft were instead placed in storage. Schmidt wouldn't say how many F-35s were being stored, but admitted that it was "a significant number." ▶



ABOVE:
The F-35A's low observable capabilities provide the aircraft with an operational edge, but they also make the type more difficult to upgrade and modify than conventional fourth-generation fighters
 USAF

OPPOSITE:
Some of the hardware elements of the Block 4 upgrade – as it was conceived before being 'truncated'
 Lockheed Martin

During 2023, Lockheed Martin built approximately 158 F-35s of all versions, but it delivered only ninety-eight of them and stored the rest pending the TR-3 software update being ready. More aircraft may be in store awaiting a TR-3 retrofit and, in January 2024, Lockheed Martin said that the number could rise to 100-120 aircraft. The Pentagon has reportedly withheld payment on sequestered aircraft.

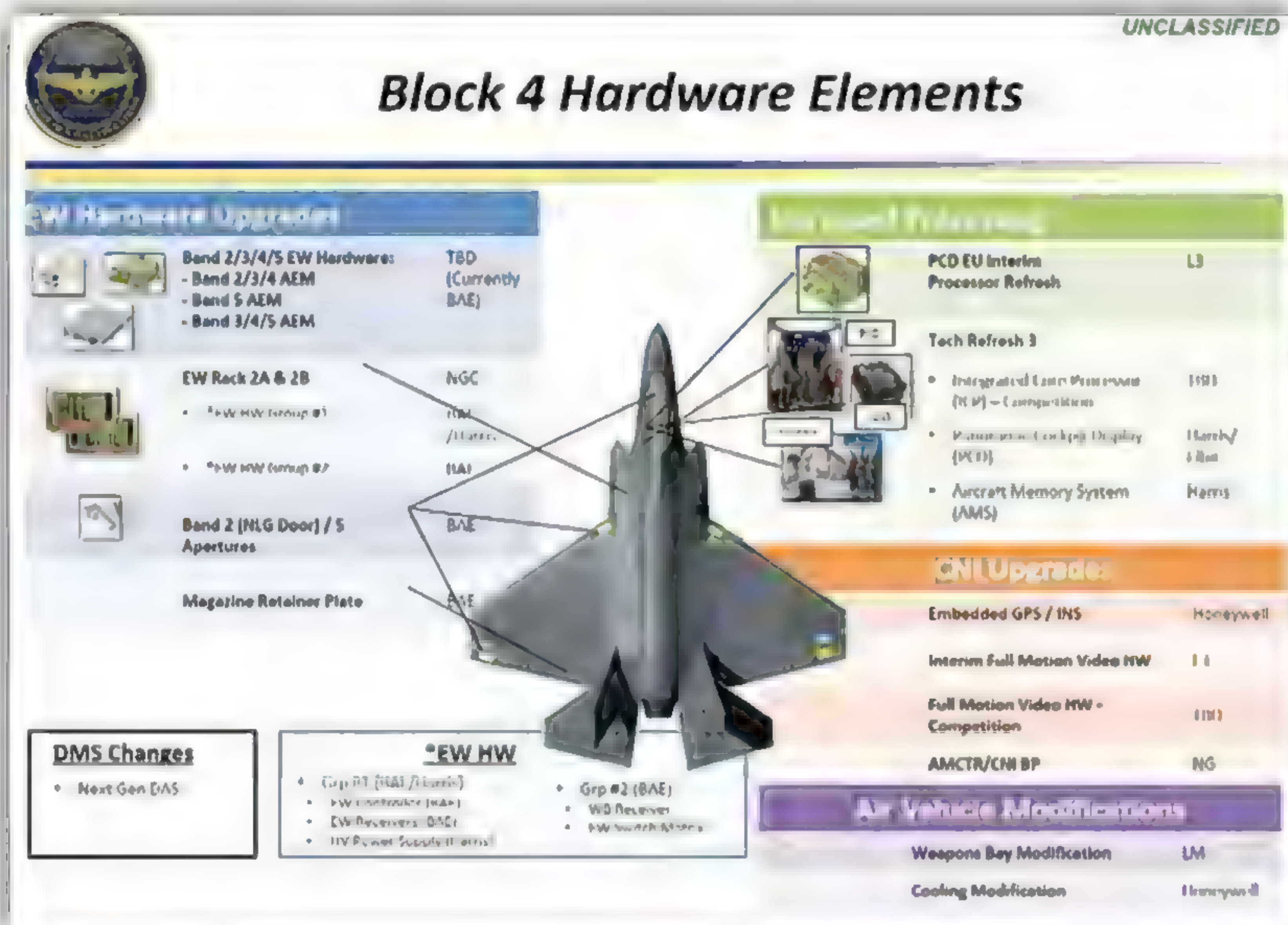
It has now emerged that the software delay masked deeper hardware issues. Schmidt told the House subcommittee that only 21 of the 52 F-35s that should have been ready for delivery by the end of December contained all of the required TR-3 hardware, with two unspecified components causing a bottleneck in the ramp-up. Problems with "hardware design maturity" had resulted in "low manufacturing yields of parts necessary for aircraft production." Lockheed has predicted that it will start delivering jets equipped with TR-3 in the third quarter of 2024, between July and September, but at the end of April, the JPO would still only accept new F-35 deliveries once the TR-3 software had been fixed.

There does not seem to be much confidence that a resolution to the software problem will be quick or easy, and the performance of Lockheed's

ground-based software laboratories has not inspired optimism. Schmidt told the subcommittee: "The data tells me [the software problem fix] will be in the middle of spring, but I would have had a more positive answer six months ago of when I thought it would be. I don't have a super-solid sense that I can guarantee you this date."

Subject to getting a stable, capable, maintainable version of the software, and assuming that terms and conditions can be agreed with Lockheed, the F-35 Joint Executive Steering Board (JESB) representing the US and international F-35 partners and customers has agreed the criteria under which they would accept an interim, 'truncated' version of TR-3 that does not include all the planned capabilities. Rob Wittman, the subcommittee chairman, said there would be "utility" in delivering F-35As with a truncated TR-3 capability, even without full combat capability, to offer practical training, while existing TR-2 training aircraft could easily be combat-coded.

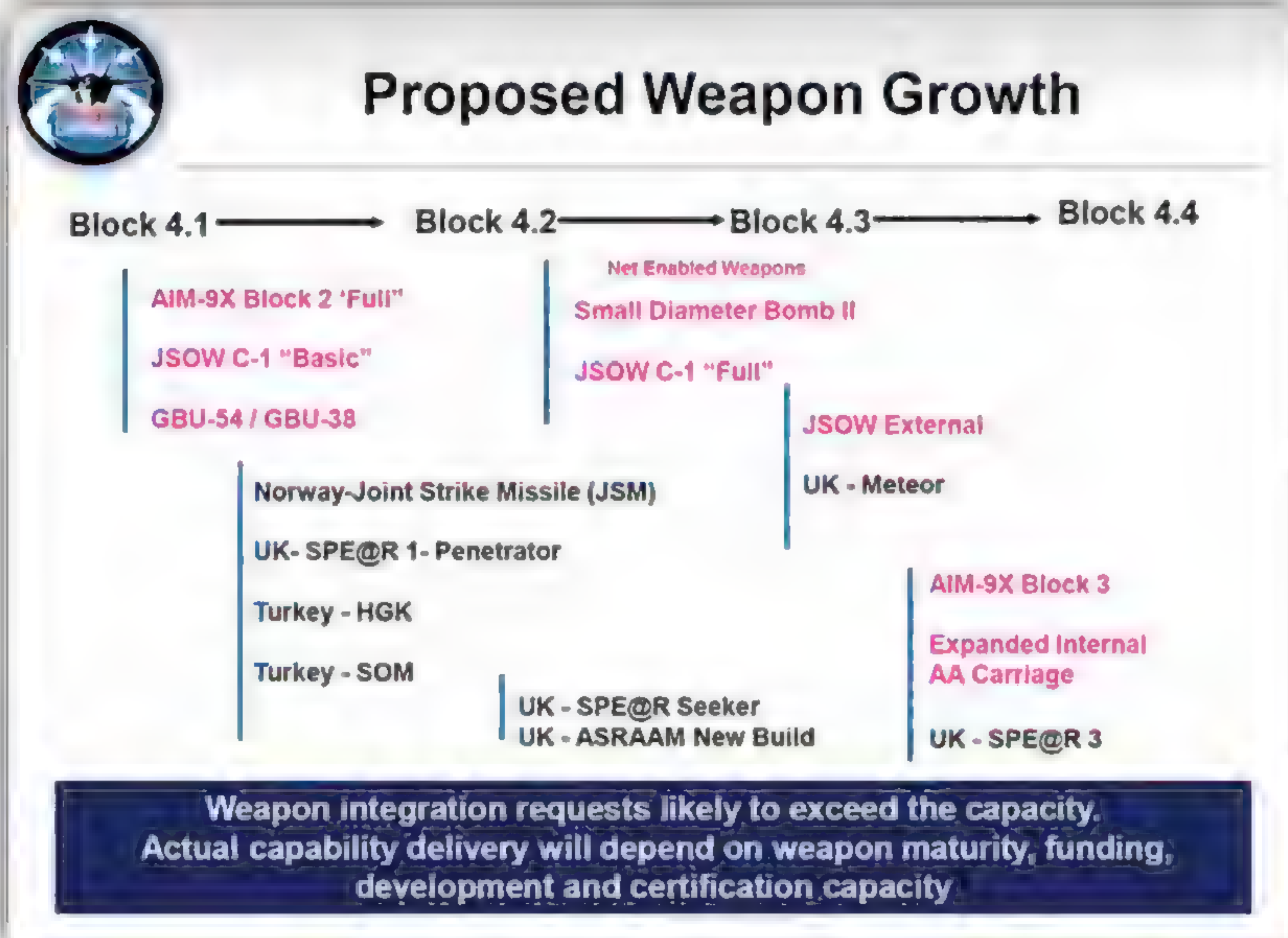
Under the new plan, the TR-3 software would be released in two separate drops. The first would be a truncated version, release 40P01, to be used for training and not combat-coded. But even that version would need to be proven stable and airworthy, which would depend on



fixing specific issues in the TR-3 software and improving stability on the ground and in the air. If the truncated version of TR-3 needed additional incremental software releases to test and implement critical fixes, additional software releases could be required, with each such release taking between two and six weeks, delaying the final, fully combat-capable software load (40P02). However, if the truncated release were to be “right first time”, the second release could come about 12-16 months later, but there are no set timescales. Schmidt admitted: “I am as frustrated as you that I can’t nail down a specific date and be extremely clear about exactly when we will deliver. I need to change that narrative.”

While TR-3 is expected to be achieved eventually, things are looking less rosy for the Block 4 upgrade, which may now have to be “reimagined” or completely restructured. Block 4 was initially conceived to keep the F-35 operationally viable, enabling future capabilities to ensure that the F-35 retained its edge and state-of-the-art warfighting capabilities. The upgrade aimed to increase cross-platform interoperability and ensure that the F-35 would be able to continue to deter and defeat threats while bringing its pilots home safely.

The upgrade was expected to include 11 sensor enhancements (radar and electro-optical system) including a new Northrop Grumman AN/APG-85 radar (for US aircraft at least), which would probably incorporate Gallium-Nitride (GaN) TRMs, allowing it to produce more power while generating less heat while providing better capabilities against challenging air targets. Block 4 also added radar enhancements for the extended surface warfare mission, with improved maritime surveillance, identification and targeting performance. The upgrade was originally also expected to include 13 electronic warfare modifications (including an updated BAE Systems AN/ASQ-239 electronic



LEFT: Lt Gen Michael Schmidt, program executive officer for the F-35 Lightning II Joint Program Office (JPO), left, poses for a photo with Air Marshal Harvey Smyth, the United Kingdom Royal Air Force air and space commander, at the F-35 JPO headquarters in Crystal City, January 17, 2024. The poor progress of TR-3/Block 4 is sure to have been one of the topics of conversation US DoD, Walter Estrada



warfare suite), seven interoperability and networking enhancements, seven cockpit and navigation upgrades, eight logistics and support system changes and more powerful data fusion.

Block 4 aircraft were to have been integrated with several new long-range and precision-guided weapons, including the Raytheon GBU-53/B small diameter bomb II, the Kongsberg joint strike missile, the Roketsan SOM-J cruise missile and British ASRAAM, Meteor and SPEAR weapons (ASRAAM is already cleared for external carriage, of course). US Navy F-35Cs would also be able to launch the AGM-154C1 joint standoff weapon.

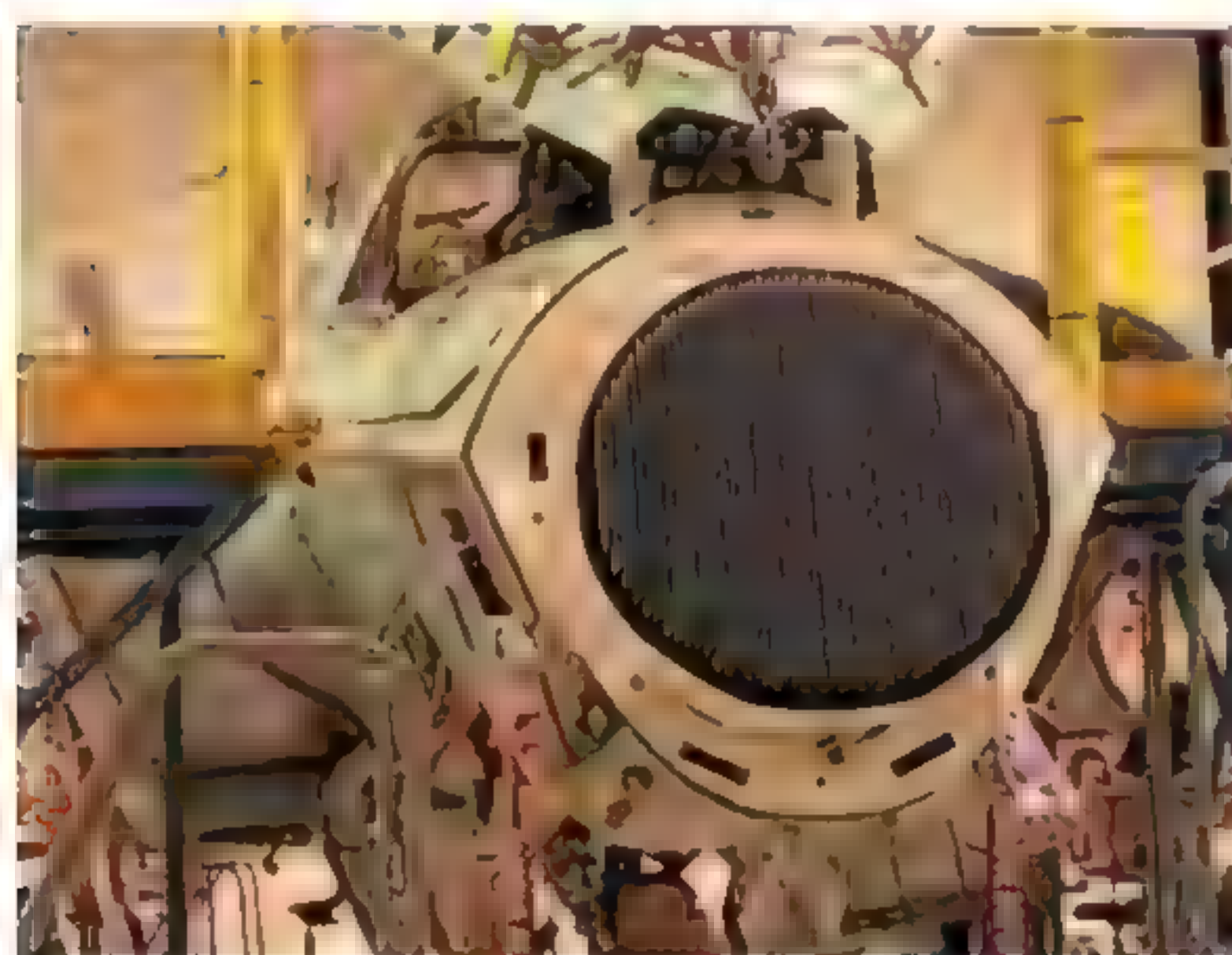
The scope of the Block 4 upgrade

increased over time, going from 53 to 66 then to more than 80 significant changes as the design was adapted to the ever-more-drastically evolving threat. Vice Admiral Mathias W Winter, the previous F-35 Program Executive Officer, had stressed that Block 4 should be “technically feasible while operationally relevant”, explaining that “we don’t want to overcommit. It’s got to be technically feasible.” Despite that intention, Lockheed seems to have over-reached itself on the upgrade. This may be due, in part, to the same kind of ‘concurrency’ that plagued the core programme. The Government Accountability Office was ignored in June 2018, when it recommended that

a Block 4 contract award should be delayed until initial operational testing was complete. The JPO placed the contract in November 2018, citing the rapid advance of threat systems, which it insisted posed an urgent risk.

But all that, as they say, was then. The Block 4 upgrade now faces a more uncertain, ‘reimagined’ future.

Schmidt told the House subcommittee that an independent review last year had determined that “numerous Block 4 capabilities will not be delivered until the 2030s”, years later than a recent estimate offered by congressional auditors, and that this was what had prompted the programme to ‘reimagine’ the Block



ABOVE:

The AN/APG-85 will replace the F-35A’s AN/APG-81 radar in Block 4, though the new set will have to fit the same volume, relying on new technologies (including GaN semiconductors) to leverage enhanced performance. A fixed AESA now seems

archaic to many!
Northrop-Grumman

RIGHT:

The already-bleeding edge F-35 cockpit will receive new displays as part of TR-3. Questions remain about whether the TR-3 and Block 4 upgrades will actually deliver the capabilities required for

tomorrow’s fight
Lockheed Martin





4 upgrade altogether. In doing this, Schmidt promised: "Lessons learned in the execution of the TR-3 programme will be applied across the entire Block 4 modernisation programme."

The reimagined Block 4 will focus on delivering must-have content and on what industry can deliver across the Future Years Defense Program (FYDP), consistent with the JESB-directed development funding cost cap. This will reportedly include an undefined subset of 88 capabilities – "Those which give us the most bang for the buck" – and will be delivered in "a combat-relevant timeframe". This will be ensured by tying particular hardware and software to agreed capability decision points (CDPs). So Block 4 would include "common capabilities for electronic warfare, communication, navigation and identification, sustainment and new weapons for the partnership, plus US service-unique capabilities and partner-unique capabilities." Schmidt did not elaborate further, but he did say that success would require buy-in from all members of the F-35 enterprise.

Subcommittee chairman Rob Wittman responded: "I want it [the Block 4 plan] to reflect reality. I want them to understand what can you do realistically." He also hoped that the reimagined programme would pioneer an approach that would help work on the next-generation NGAD effort: "Block 4 ought to be an experience that can not only get us further in the software design and upgrades for the F-35, but it also should inform what we're doing in digital design and digital twin development."

The Block 4 upgrade requires more electrical power and improved thermal management. At one time, an all-new engine was planned, with Pratt & Whitney and GE Aerospace given contracts to develop adaptive cycle engines for the F-35, and delivering prototype Adaptive



Engine Transition Program (AETP) engines to the USAF for testing and evaluation in 2022. The new engines offered a massive increase in performance, with GE's XA100 engine delivering at least 20% more thrust and 30% more range than the current engine, but the cost of re-engining the fleet and problems adapting an AETP design to the F-35B led to the cancellation of the entire programme. Instead, the JPO is beginning work on a more modest F135 engine core upgrade (ECU), together with an associated programme to improve the aircraft's power and thermal management system (PTMS).

Air International understands that the reimagined Block 4 upgrade will reflect US warfighter priorities, which could mean bad news for anyone waiting for the integration of weapons such as Meteor and SPEAR. We are still determining whether even an upgraded F-35 will be adequate to meet the rapidly evolving and increasingly contested threat environment. Perhaps it is time for the UK to breathe a collective sigh of relief that work is progressing on GCAP. **AI**

ABOVE:

These aircraft (an F-35A nearest the camera and an F-35C) were pictured while testing the TR-3 configuration
USAF

TOP:

This aircraft (20-5578) was the first TR-3 jet for the 461st Flight Test Squadron, arriving with the unit in August 2022, when it still looked brand new and pristine
USAF

OPPOSITE TOP:

Major Ryan 'Bolo' Luersen from the 461st Flight test Squadron, made the first flight of an F-35 in the Technology Refresh 3 (TR-3) configuration on January 6, 2023, at Edwards Air Force Base, California. The F-35 is claimed to be the most lethal, survivable, and interoperable fighter ever built. It may also be the most troubled USAF programme in recent history

USN/Chief Mass Communication Specialist Matthew Olay



For a range of reasons, carriers that help scheduled airlines maximise their offering are being called on more often. **Bernie Baldwin** reports on how wet-lease/ACMI carriers are thriving





'At your service'

airlines

"Capacity as a service is what we do. That's the strapline on our website", said CityJet chief commercial officer Cathal O'Connell, defining his airline's role as an aircraft, crew, maintenance and insurance carrier (ACMI) – sometimes described as a wet-lease operator.

He continued: "We turn up at the gate with the aircraft, in whatever colours you want on it, with the crew in whatever uniforms you want, and we fly your passengers. That's the service we provide."

As the initialism denotes, ACMI carriers operate flights on behalf of other airlines, using the client's flight numbers. O'Connell described the key circumstances driving use of an ACMI operator: "At a basic level, we look for

CLOCKWISE FROM TOP RIGHT: SmartLynx pilots gain unique experience flying international routes and changing bases frequently, something not experienced when flying with established airlines SmartLynx

SmartLynx technical teams help achieve the effectiveness required for high quality ACMI operations SmartLynx

The SmartLynx fleet currently operates mainly in Europe, but it has a base in India and is engaged in projects in Canada, Africa, and other regions SmartLynx

the conditions under which a customer airline is likely to need ACMI.

"That can be scheduled maintenance; if the airline doesn't want to reduce its network because of a scheduled maintenance path. That means an ad hoc four-to-six-week ACMI... or whatever the timeframe might be.

"Another scenario that is relevant today – certainly for the Airbus A320 and Boeing 737 operators – is that there may be issues in the aircraft that require them to be grounded. Obviously, that creates an open inquiry by providers, to protect their network.

"The other [scenario] we've seen a lot is the state at which carriers responded to the ending of COVID-19 restrictions – probably this is the first year we're overcoming [this]. A lot of airlines were left with aircraft that they hadn't planned to reactivate, but the market moved a little bit quicker."

O'Connell continued: "One we're more involved in, as a regional jet operator, is providing a service for an airline that wants to have a regional network, that has a hub operation and requires feed into that hub from markets that require a specific aircraft size. That's what we're doing for SAS.

"An airline – such as SAS – may not want to operate that size of aircraft because it may complicate their fleet strategy. So, being able to outsource a fairly significant part of their overall network to a wet-lease provider or several wet-lease providers, allows them to strategically build their network without having to invest.

"The benefit for the customer is they don't need to acquire the aircraft, they don't need to train the crew, they don't need to get involved in maintenance, and so on. It is a turnkey solution," O'Connell said.

Edvinas Demenius, CEO of SmartLynx Airlines, explained the challenge for an ACMI operator to work alongside different airline business models, from full-service carriers to low-fare and regional airlines: "I'd emphasise two crucial aspects of ACMI – adaptability and effectiveness. Our mission is to assist airlines in managing their capacities, seamlessly adapting our services to meet their unique needs and ensure operational continuity.

"This demands significant expertise and resources to provide crew and aircraft in excellent condition promptly. With more than 30 years of experience across diverse markets like Europe, Southeast Asia, Canada and Africa, our task is consistently delivering a high-quality, reliable service regardless of the market, destination or client.

"Above all, effectiveness is key. A high number of block hours signifies more flights operated and better technical reliability. With our diverse fleet, we're heavily focused on maintenance and continuously improving our processes to ensure the persistent improvements in the reliability," Demenius added.



Diverse needs

Avion Express is part of the Avia Solutions Group (ASG), the world's largest ACMI provider, which also has fellow wet-lease carrier BBN Airlines Indonesia in the group. The former's CEO, Darius Kajokas, believes the ability to thrive depends on several factors, including adaptability. "As an ACMI operator, we must swiftly respond to market demands and tailor our services to meet clients' specific needs," he remarks. "For instance, during the post-pandemic period, ACMI demand surged dramatically. Avion Express expanded its fleet from 12 to 50 aircraft illustrating the viability of the ACMI model in a dynamic market landscape.

"Our primary strength lies in our ability to adapt swiftly to diverse situations. For example, when entering geographically distant markets, like Vietnam this winter, Avion Express promptly established operations: set up a base, prepared aircraft, and allocated crews and engineers," Kajokas recalls. BBN Airlines Indonesia's CEO Martynas Grigas, says that the market for ACMI operators presents unique opportunities driven by various factors: "To thrive, flexibility is paramount," he said. "Working

alongside airline business models, whether focused on long-haul or short-haul routes, demands adaptability in fleet configuration, crew management and service level agreements. ACMI operators must cater to diverse operational needs, from short-term ad-hoc charters to longer-term contractual partnerships, requiring a deep understanding of each client's business model and market positioning."

One of the challenges ACMI operators face is juggling the calls on its services between short-term 'infill' and longer-term support for other carriers. For Grigas, the key is strategic resource management: "Our aircraft, for example, are strategically placed to meet evolving demands. BBN Airlines' fleet is currently deployed across Southeast Asia and neighbouring regions, supporting multiple carriers with flexible ACMI solutions tailored to their specific route networks and seasonal fluctuations," he said.

According to Kajokas, Avion Express prioritises long-term partnerships over short-term, ad-hoc flights. "Long-term collaborations involve close cooperation with our customer airlines. When establishing long-term partnerships, we are not only able to adapt in visible





“As an ACMI operator, we must swiftly respond to market demands and tailor our services to meet clients’ specific needs”

Darisus Kajokas, CEO,
Avion Express

CLOCKWISE FROM BELOW:

It might be all-white now, but when establishing long-term partnerships, Avion Express will adapt visible aspects such as aircraft livery for the client
Avion Express

CityJet is so aligned with the SAS product that this sign by the aircraft door is the only visible difference that passengers should notice
CityJet

While internal elements do get adapted to the customer brand, the Avion Express name is still visible on safety cards
Avion Express



aspects, such as aircraft livery and interiors, but also operationally, based on each client’s requirements,” he comments. “Fostering partnerships involves engaging in face-to-face meetings to understand different markets and work cultures and directly address expectations, ensuring smooth processes throughout our collaboration.

“We now have more than ten long-term partnerships. In our history, several partnerships have lasted for more than five years, while the shortest one could last for one flight rotation, based on the ad-hoc requirement from our customers,” Kajokas continues. “While we are capable of short-term contracts, our preference lies in establishing more long-term partnerships. During 2024 season we will have our aircraft in more than ten countries.”

CityJet’s O’Connell also appreciates the juggling scenario – when aircraft are available, an event occurs and a decision is needed over whether it can be covered without impinging on the structural agreements: “Mostly, you’re happy to go in there, but you’re not likely to invest for that scenario,” he said.

“There are shorter-term, seasonal, regional jet requirements out there. We probably could have had six or eight more aircraft placed this summer. If you have aircraft available, then use them. But for us to invest in bringing aircraft into our fleet, ideally, you want a long-term contract attached to that,” O’Connell explained. “The cost of carrying aircraft over winter is obviously a challenge for any airline if you don’t have production on that aircraft. The only realistic way to recoup that cost is by charging higher prices during the summer, which affects your competitiveness as a wet-lease provider.

“I think when you look at the amount of flying that you would perform on something like an A320 or a 737, those aircraft tend to operate in markets where you may get 300-350 block hours out of an aircraft in a month,” he continued. “Regional jets tend to fit with more business-type schedules. So, the typical regional jet comes active around 0600-0700hrs and is parked overnight by about 2200hrs. There isn’t the same opportunity to do a significant number of hours per aircraft. You may do 250-270 hours per

aircraft, but you will always be able to get more hours out of a larger aircraft through the summer season because of the nature of the markets into which they’re deployed.

CityJet’s structural role enables frequency, which makes the carrier a year-round proposition for work with the likes of SAS. They might otherwise only be able to do one flight a day or one every other day if they didn’t take on regional jets.

“There are many markets around Europe which only make sense with frequency and only make sense with a regional jet operation. That’s the niche that we play in. Regional jets around Europe average flights about an hour to an hour and 20 minutes so that routes can have a higher frequency,” O’Connell said. “If they are feeding a hub, that frequency will tend to be aligned with the waves that feed the hub. Look at CityLine, CityHopper or HOP! I suspect that the majority of the passengers on those flights are connecting [with Lufthansa, KLM and Air France, respectively]. They’re a strategic part of the overall network. And without that feed coming in from regional points, you could question the viability of other operations that that airline may operate.

“Many A320/737 operators build their business model around seasonality. That’s good for them, but we prefer to have that long-term stability because it gives our crews long-term stability. It means we can plan to have the fleet active year-round,” O’Connell added. From its 21-strong fleet, CityJet currently has 12 CRJ900s with SAS and five CRJ1000s with Lufthansa for the summer season.

At SmartLynx, Demenius has noticed short-term ‘infill’ changes versus longer-term support balance: “There is a noticeable shift in the ACMI market



CLOCKWISE FROM LEFT:
Seating on one of SmartLynx Airlines' Airbus A320s
SmartLynx

Ground support for a SmartLynx Airlines 737 MAX 8
SmartLynx

Avion Express will benefit from the Pilot Runway Program, which aims to train 200 pilots annually. The programme is run in partnership with BAA Training, also an Avia Solutions Group subsidiary
Avion Express

as more airlines integrate wet leases into their long-term strategies, with some setting benchmarks, such as ensuring 25% of their capacity is managed by external partners like SmartLynx," he said. "We see this as a positive shift as it creates more predictability for our team about future operations and helps us schedule aircraft maintenance and work on product improvements.

"For clients, it offers greater flexibility to explore new routes and expand capacity without added pressure," he added. "While this shift promotes more structured engagements, we continue to reserve a number of aircraft for immediate, ad-hoc services to meet urgent client needs."

Peak season

With the summer season under way, Demenius said most of the SmartLynx fleet is operating in Europe, but added: "However, our largest bases include India – where 15 of our aircraft are leased to IndiGo – and Turkey, supporting AJET, Turkish Airlines' low-cost carrier, through wet-lease arrangements. Additionally, we are engaged in ongoing projects in Canada, Africa and other regions."

Having assessed the challenges needed to succeed in the ACMI market, the SmartLynx CEO's thoughts turn to the current market for ACMI operators, both regionally and globally: "The demand for ACMI services is closely tied to the overall situation of the airline industry, reflecting a strong correlation with the aviation market's challenges," he said. "If the market maintains its growth as it is now, and the economic climate remains stable, the demand for ACMI services will continue to grow.

"The growing reliance on ACMI services by more airlines for long-term strategies provides positive indicators for ACMI

operators, offering greater certainty and bolstering business confidence for the foreseeable future, which is an important aspect when considering fleet expansion," Demenius explained.

"We must also consider seasonality. Historically, ACMI has supported clients with additional capacity during peak seasons, with summer being particularly busy in Europe, where a large part of our fleet is stationed during that time. In the winter, we strategically shift resources to regions experiencing their high season, such as Southeast Asia, Thailand and Caribbean-bound flights from Canada," he added. "Current global market conditions enable ACMI operators like SmartLynx to adopt a counter-seasonal strategy. This means we have the necessary resources and compliance to operate across various markets and regions. This allows us to maintain yearly activity, not just in traditional European peak seasons."

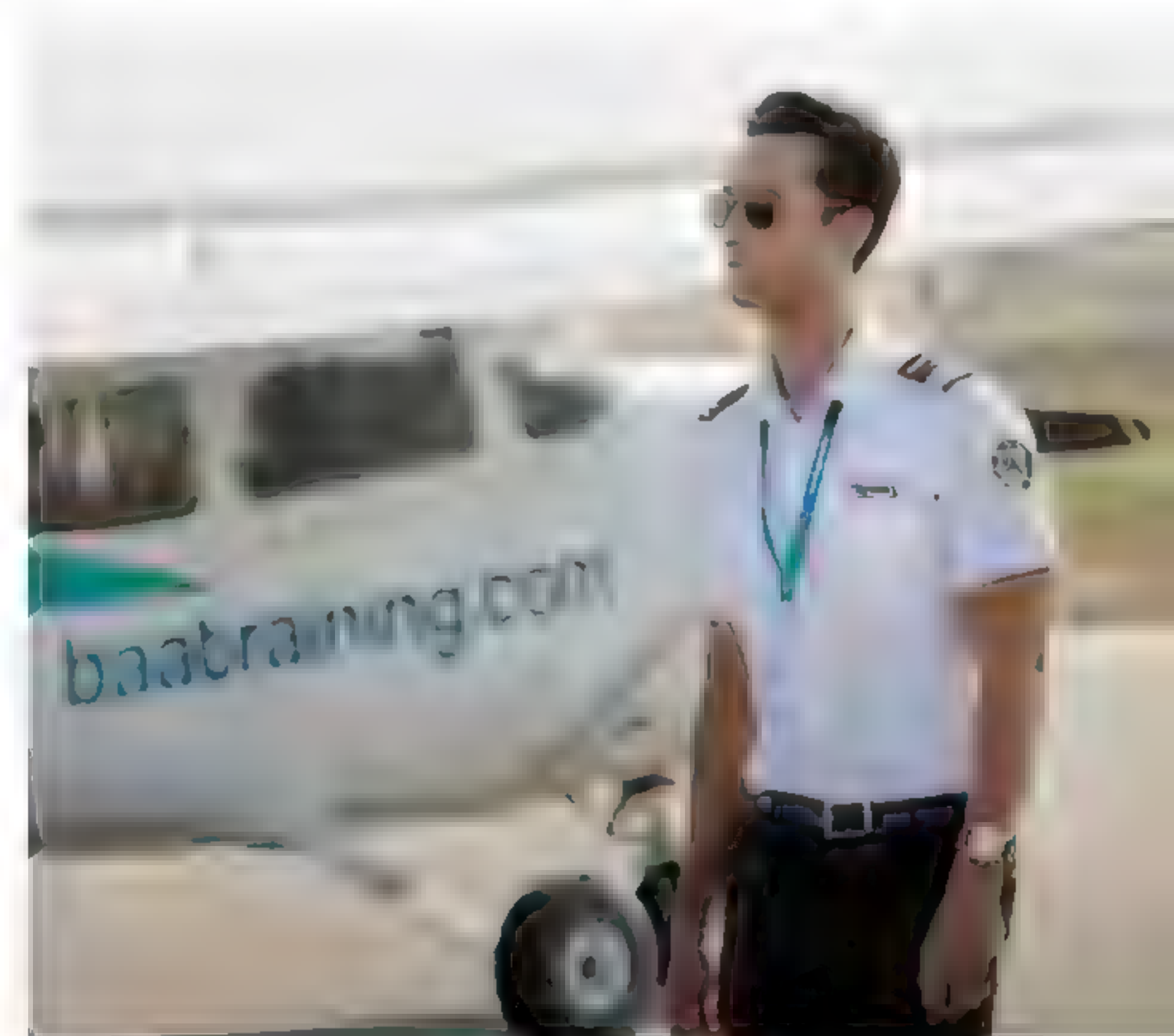
BBN Airlines' Grigas said the market for ACMI operators remains dynamic: "In Asia-Pacific, where aviation growth is robust, ACMI services are critical in supplementing fleet capacity and optimising operational efficiency for established and emerging carriers. Globally, ACMI operators are increasingly sought after due to their ability to provide cost-effective solutions amidst industry volatility and changing market dynamics."

Kajokas notes that traditionally, the ACMI market experiences, with operations peaking in regions like Europe during the IATA summer season and shifting focus to areas such as Latin America and Asia during the winter season. "Recent developments, however, suggest a shift in this pattern as partnerships in Latin America and Asia are increasingly embracing the ACMI

services," he observes. "Recently, we began ACMI services in Mexico for the first time, signalling substantial growth potential in this sector. Additionally, this winter season we had three customer airlines in Vietnam. We are committed to building long-term partnerships in five continents, which will help reduce seasonality in our business."

O'Connell is equally bullish about the market outlook: "We've turned down nine extra aircraft that we could have flown this summer had we had them. That's pretty significant, as these were requests from major airlines looking for capacity. What we've seen recently is more airlines coming to us linked to the Pratt & Whitney GTF issues, hence my earlier remark about unplanned maintenance issues – that's just one of them.

"When you look at the ad-hoc or even the short to medium-term ACMI markets, you see European airlines spreading their wings into markets further afield. Many of these carriers are now beginning to place their aircraft outside of Europe. That indicates the market is probably not tapped





“I’d emphasise two crucial aspects of ACMI – adaptability and effectiveness”

Edvinas Demenius, CEO,
SmartLynx Airlines



into, or operators from those regions do not provide for it,” O’Connell added.

He noted that some scheduled operators have ACMI as a further revenue stream: “A good example is airBaltic, [which has] a significant wet-lease business, with an aircraft size of the A220-300 that is getting into A319 and A320 territory, which is significantly more efficient. It is certainly a great aircraft for the wet-lease market.”

Crew recruitment

Whatever aircraft are being used for ACMI work, they still need a crew. How competitive are ACMI operators in attracting pilots, especially as there are well-reported shortages of qualified personnel in some regions?

Edvinas Demenius readily admits that the aviation industry, including SmartLynx, has faced a pilot shortage over the past three years, but he remains

positive: “ACMI carriers operate differently from traditional airlines, offering an unpredictable, dynamic environment. Our pilots frequently need to adapt to changing circumstances, which can be challenging but also enriching,” he said. “They gain unique experience flying international routes and frequently changing bases – from Brussels to Delhi to Lagos. You do not experience that when flying for established airlines; many pilots value this experience and lifestyle.

“In response to the pilot shortage, we have prioritised retention by continuously improving processes and working conditions to ensure our pilots are satisfied and feel valued and proud to fly with SmartLynx,” he added.

Conversely, Martynas Grigas says ACMI operators like BBN Airlines Indonesia have been fortunate in Southeast Asia: “Here, the market is currently flooded with qualified personnel.

“The abundance of skilled aviators in this region has allowed us to attract talented pilots to join our team. This surplus of qualified personnel enables us to maintain operational flexibility and meet the demands of our clients effectively. BBN Airlines remains committed to leveraging this advantageous market condition to continue providing exceptional ACMI services to our partner airlines.”

Kajokas admits that attracting pilots remains a constant focus. “We continuously review and improve conditions and remuneration packages to remain competitive. We also nurture out internal culture, conducting regular surveys and maintain open channels of communication to incorporate pilots’ feedback into working conditions and benefits,” he reports.

In terms of training pilots, we have strengthened our partnership with BAA Training – a daughter ASG company



“The abundance of skilled aviators in this region has allowed us to attract talented pilots to join our team”

Martynas Grigas, CEO,
BBN Airlines Indonesia

BBN Airlines Indonesia's fleet is currently deployed across across southeast Asia and neighbouring regions
BBN Airlines



like us – by cooperating with them in the purchase of a brand-new full flight simulator dedicated to Avion Express. This helps us to create convenient and high-standard training possibilities for our pilots.

“We are also cooperating with BAA Training regarding a project called Pilot Runway. As part of this project, Avion Express will finance student pilot studies. In approximately two years, after successfully completing studies, pilot cadets will join Avion Express as our new pilots.

O’Connell believes attracting crew can depend on where the pilot is resident, as a crew member in a wet-lease operation can expect to spend a lot of time away from home: “That’s just the nature of ACMI. That may appeal to some crews, but not to others. It allows you to fly a variety of flights. You may be flying in

different markets every season, which is a good experience. But wet-lease airlines are not immune to the market factors out there right now,” he added.

“Major airlines are currently recruiting and for a crew member at a wet-lease provider, there are opportunities to move. That means making sure you do what you can to make your crews want to stay with you, which can be lifestyle, work-life balance, or the various kinds of operations you can offer them.

“From our perspective, we now do type ratings on the CRJ900 through our training organisation. We see that as being essential now for recruiting. You have to be able to offer type ratings for new crew. We always work with crews to ensure that what we’re doing is aligned with their career ambitions,” he reported. “Continuous recruitment and upgrading

crews are a must because we know we are susceptible to any spikes in the market. Also, crews tend to look at regional jets as being on the first few rungs of the ladder that defines the career path.”

CityJet currently has 600 people, of whom just under 500 are based in Scandinavia. O’Connell said: “They’re spread between Copenhagen and Stockholm. If we had an Ireland-based crew contingent and had to have them flying in Scandinavian, we’d be looking at hotels and per diems and so on, which would add to our costs.”

Adding seasonal capacity, filling in when there are issues and providing frequency on thin routes – the ACMI provider has plenty to offer providing “capacity as a service”. With the right plan and flexibility, an increasingly buoyant market awaits. **AI**

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Future nostalgia

The rebirth of seaplanes is underway, with several manufacturers aiming to usher in a new generation of waterborne aviation, as **Alex Preston** discovers

Enhanced market drivers and improved designs are ushering in a new generation of seaplanes

Elfly Group

Since the earliest days of aviation, engineers have sought to extend aircraft capabilities by using bodies of water for take-off, floating and landing.

Within seven years of the Wright Brothers' Wright Flyer making the first controlled, sustained flight of an engine-powered, heavier-than-air aircraft, French aviator and inventor Henri Fabre made the first successful seaplane flight. In 1910, in the waters off Marseilles, France, Fabre flew his Hydravion 500 metres,

initiating new possibilities for aviation.

Seaplane is used synonymously to refer to aircraft designed for waterborne aviation and can be divided into two categories: floatplanes and flying boats.

Like the Hydravion, a floatplane is an aircraft equipped with pontoons or floats instead of wheels mounted under the fuselage. Some floatplanes, known as amphibious aircraft, have retractable landing gear inside their pontoons, allowing them to take off and land on water or land. The Hydroaéroplane Gaudron-Fabre, built in 1911 by





“The Albatross G-111 has not been commercially manufactured for six decades”

the French aircraft company Caudron, is often cited as the first amphibious aircraft. A flying boat is a particular seaplane construction where the fuselage is a seaworthy hull.

Despite widespread runways on land, the versatility of seaplanes made them ideal for various purposes, including cargo, commercial, and military. From the 1930s until the outbreak of World War Two, seaplanes were at the heart of the Golden Age of Aviation, offering new levels of luxury and space for transoceanic flights, pioneered by the likes of Pan American Airways' Boeing 314 Clipper and Qantas' Short Empire flying boats.

However, the post-war period saw a decline in the popularity of seaplanes, as advances in jet engine technology, the emergence of longer runways and unfavourable economics threatened such aircraft with obsolescence.

seaplane. Both models are manufactured in composite materials.

Formed in 2017 and headquartered in Wuxi, Jiangsu province, China, Dornier Seawings is a joint venture between the Dornier family and two Chinese state-owned enterprises: the conglomerate Wuxi Communications Industry Group Co. Ltd and Wuxi Industry Development Group Co. Ltd., one of China's leading enterprises. Both are based at Wuxi, near Shanghai.

The company operates two facilities. Managed by Dornier Seawings GmbH, its facility at Oberpfaffenhofen Airport, close to Munich, is the base from which it provides technical know-how, designs, builds and tests the prototypes and handles the serial productions of Seastar CD2. In addition to providing significant financing in Wuxi, the Chinese entity manufactures aircraft parts, including fuselage and wing components in



Leading the charge

And while the era of large flying boats may be over, seaplanes are enjoying a renaissance driven by a new generation of avionics and design. “We believe that there is a potential market of 200-250 [aircraft] to be delivered within the next ten years,” says Ana Alvarez-Munoz, HO Marketing and Sales at Dornier Seawings. She cites several factors behind this optimism, including the increase in luxury tourism, the demand for fast commuting flights in coastal areas for high-income individuals, the need to connect remote areas inaccessible by other means, the interest of adventurers, and the replacement of some old existing fleet of seaplanes mainly used for scenic flights and premium touristic operations.

Dornier Seawings intends to develop, certify, manufacture and sell seaplanes. Two models are in the pipeline: the Seastar, able to transport up to nine passengers, and the DS-2C, a two-seater

composites, scales up final productions of CD2, and builds the DS-2C.

Inspired by the design of the earlier Dornier Wal of the 1920s, the CD2 (the CD is a nod to Claudius Dornier, founder of Dornier, while the two refers to it being the second prototype of the Seastar) is powered by two powerful Pratt & Whitney PT6A-135A turboprop engines with five-bladed propellers from MT-Propeller, mounted above the fuselage, the in-line push-pull engine configuration eliminating asymmetric thrust in the event of an engine failure. Moreover, over-wing placement minimises the possibility of Foreign Object Damage and water ingestion into the engine intakes.

“This design choice leverages historical Dornier seaplanes and involves trade-off analysis to select the most efficient design based on aircraft operations, performance, manufacturing processes, and market drivers,” comments Alvarez-Munoz.

The entire fuselage and wing are



manufactured in composite materials, giving them a level of protection from corrosion that other metallic-structure aircraft don't have. The sponsons are attached to the centre fuselage section. This optimised design results in smooth water landings and short take-off runs. The sponsons house the fuel and the main landing gear, keeping the centre of gravity at the lowest point. In addition, they act as a working platform.

The cockpit features Honeywell's Primus Epic avionics suite, with advanced vision, communication, navigation, surveillance, and air traffic management systems allowing for single- and dual-pilot operation. The cockpit is cleared for Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) and is also equipped with an Anti-Ice System that enlarges the aircraft envelope.

The cabin can accommodate up to nine passengers in a commuter configuration or up to six passengers as a VIP (or yacht feeder). Other configurations, such as Medevac or cargo, can be accommodated if the market demands.

As for its technical specifications, Seastar has a maximum take-off weight (MTOW) of 5,100kg and a maximum fuel weight (MFW) of 335 US gal. Its maximum speed is 180 kts (knots true airspeed) with a ceiling height of 15,000ft, a rate of climb of 1,079ft/min (two-engine) and 392ft/min (one-engine), and a maximum range of 90nm. Distances in land for take-off (TO) and landing (LND) are 2,250ft and 2,600ft, respectively, while on water, distances for TO and LND are 3,450ft and 2,800ft, respectively.

A phoenix rises

Another company straddling the past with a new, updated design is Australia's Amphibian Aerospace

Industries, Pty Ltd (AAI).

AAI holds the US Federal Aviation Administration (FAA) Type Certificate for the HU-16 military and civilian version G-111 of the iconic Albatross Amphibious aircraft.

As The Type Certificate Holder for the Albatross family of aircraft, AAI's vision is to be a world leader in developing and producing amphibian aerospace capabilities.

The Albatross G-111 has not been commercially manufactured for six decades, and the existing aircraft will be used as the prototype to manufacture upgraded, Civil Aviation Safety Authority (CASA) approved versions to be named the G-111T (Albatross 2.0). These versions will be utilised in the critical sectors of defence, tourism, border security, and search and rescue operations.

The 13-tonne plane, which will be powered by PT6A-67F turboprop engines from Pratt & Whitney Canada, will be manufactured at the newly created 20-hectare Aerospace Manufacturing Precinct, which is under development at Darwin International Airport. The airport aims to become the home of amphibian aircraft manufacturing in the country.

The move to Darwin is being helped by the Territory's Labour Government, investing up to AUS\$10m (£5.5m) into the company through the Local Jobs Fund ➡



CLOCKWISE FROM ABOVE:

The G-111T is a modern take on a classic amphibian design

AAI

The E-Deck facility at Teuge International Airport

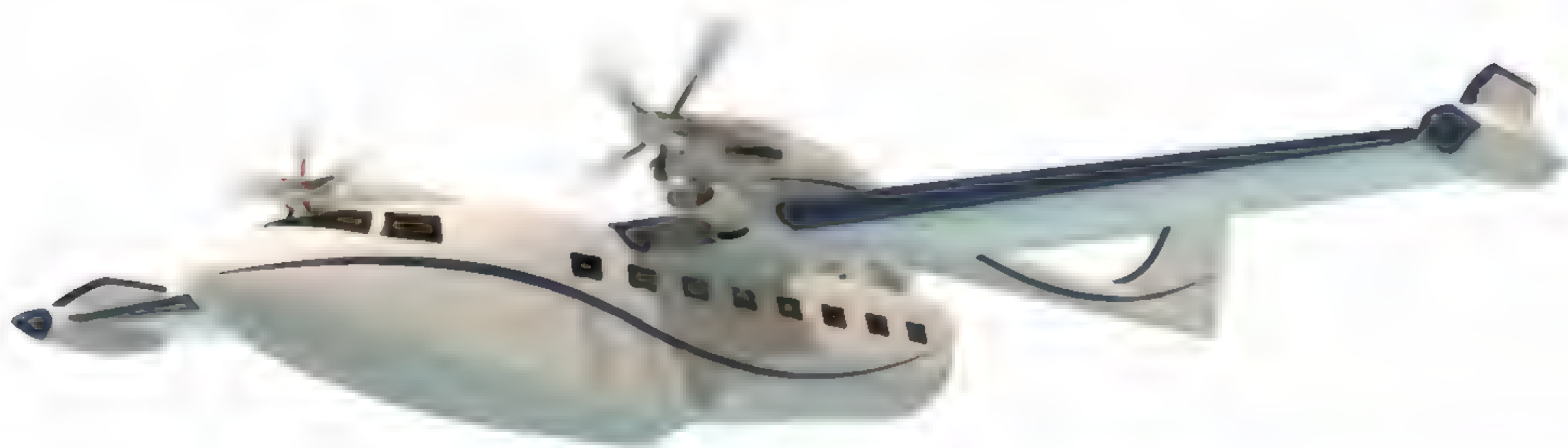
Cormorant

Amphibian Aerospace Industries (AAI) is bringing back the G-111 Albatross as the G-111T, with turboprop replacing the previous piston power

AAI



“The Norwegian government invested in electric aircraft in Europe, contributing NOK87 million (£6.3m) to NOEMI (No Emissions), the proposed electric seaplane from Elfly Group”



via staged milestone-based payments. It supports the AUS\$1,000,000 (£515k) investment from the Paspalis Innovation Investment Fund (PIIF) as the 2021 Croc Pitch winners.

Buoyed by a memorandum of understanding signed with Japanese aircraft manufacturer ShinMaywa to develop the amphibian aircraft manufacturing hub, AAI is forecasting annual revenue of over AUS\$100 million (£51.5m) by the end of the decade.

Although the final design is yet to be confirmed, the Albatross 2.0 Commuter promises to offer a maximum seating capacity of 28 passengers in a 188cm full-standing height cabin. With a range of 2,000nm, the cabin also features a fully functional washroom and separate luggage compartment.

The existing technology developments on Sustainable Aviation Fuels (SAF) for Seastar's and Albatross 2.0's PT-6A engine could make them perfect candidates to benefit from this technology soon.

A new fjord vehicle

The Norwegian government invested in electric aircraft in Europe, contributing NOK87 million (£6.3m) to NOEMI (No Emissions), the proposed electric seaplane from Elfly Group.

The 5.7-ton NOEMI aircraft will primarily take off and land on water, powered by two electric motors with a 1MW combined output from a 1.5-ton battery pack at the bottom of the hull. This gives the aircraft a low centre of gravity, which is beneficial in waves. Designed for journeys of around 170kts, the aircraft will have a top speed of 250km/h.



According to the company, the hull will be built with composite materials, and the electric motors won't need oxygen for combustion, reducing maintenance costs due to corrosion compared to conventional seaplanes with a combustion engine.

Once certification is obtained, NOEMI will be available in three variants. The first to be offered will be a nine-seater commuter version with luggage; a VIP layout with just six seats could also be offered, opening up charter options. Finally, a tourist model with 13 seats is also planned.

Test flights are expected to take place in 2026, with entry into service of 20 ➡

CLOCKWISE FROM ABOVE:

Cormorant; a practical/ electrically-powered, adaptable, eight-seat amphibious aircraft with a focus on sustainability Cormorant

The Lofoten Regional Council will work with Elfly to develop the seaplane to help support the region's economy and travel and tourism sectors Kristian Louis

The NOEMI's hull will be built with composite materials, and the electric motors won't need oxygen for combustion, reducing maintenance costs Elfly Group

Nine to 13 passenger electric seaplanes that can also move up to one tonne of cargo – quietly and with no emissions, may prove to be the solution for city harbour routes in Norway Elfly Group

Mallard Enterprises' ME-1A is garnering interest, recently signing a letter of intent (LOI) for four ME-1A Amphibious Aircraft with Skylinks Aviation in India Mallard Enterprises



aircraft scheduled for 2030.

The recent signing of a letter of intent with the Lofoten Green Islands, a private-public partnership for sustainable development, has enhanced Elfly's ambitions.

The Lofoten Archipelago in Arctic Norway aspires to be a pilot region for zero-emission air travel. The goal is for all air traffic to, from, and within Lofoten to have zero direct CO2 emissions by 2035.

As Head of the Lofoten Regional Council Vidar, Thom Benjaminsen, explains, Lofoten is a spectacular but demanding geographical area where ground travel takes a long time. For example, it takes about 3hrs 40mins to drive the 79 miles from Svolvær to Reine. With NOEMI, this could be reduced to under 30 minutes.

"An electric plane that can land at sea, in a safe and good way, within a cost level that makes this accessible also to the locals, will be very good for Lofoten. We can more easily reach all our settlements on the islands," Benjaminsen says.

"Electric seaplanes of this type, with boat hulls and good stability, can add new and exciting travel opportunities within Lofoten. I can easily imagine a trip between the fishing villages in Lofoten



by seaplane from port to port," says Hanna Sverdrup, Mayor of Moskenes municipality. "Electric seaplanes can open new business opportunities for Reine, Lofoten's most popular and iconic destination, and create new travel experiences within Lofoten."

As part of Plug Nord, Lofotkraft

Muligheter AS is expanding power and charging solutions in the ports of Lofoten and hopes to be able to supply Elfly as well.

As Alvarez-Munoz explains, such support is crucial, as in some areas, there are still some challenges to overcome regarding seaplane operations due

to either the lack of a clear regulatory framework or because the seaports (and specific areas around them) have to be cleared.

She adds: "When thinking of remote territories, seaplanes provide a significant benefit as there is no need to build additional infrastructure such as an airport, thus preserving the existing ecosystems and having a minimal environmental impact."

seats. Small carry-on luggage can be stored under the seat or in overhead bins, and more oversized carry-on luggage can be secured in the cargo area to the rear. Passengers will enter and exit the 840cu ft cabin, with the aircraft having a projected useful load of 8,000lb through the rear ramp or left aft door. It will have a range of 350nm (648km).

A VIP/Executive (for six passengers and an extended range of 1,050nm (1,945km),



Maine role

From its base at Brunswick Landing, the former Brunswick Naval Air Station in Maine, Mallard Enterprises is designing the ME-1A. It claims it will have a cruise speed of 240kts, making it approximately 100kts faster than a comparable-sized aircraft of floats. The company says this speed advantage means the same distance trip can be flown in 42% less time.

The brainchild of Dan Peabody-Harrington, a graduate of the Maine Maritime Academy and the Roux Institute at Northeastern University, and his father, when configured as a passenger transport, the twin turboprop (as of writing supplier unknown) ME-1A will have a forward lavatory and up to 19 passenger

medivac, cargo, firefighting, and military multi-mission variants are also planned.

According to promotional material, the integrated flight deck and the single-lever integrated digital engine will allow the ME-1A to be certified for operation by a single pilot. The aircraft engines that will power the ME-1A have been certified to use sustainable aviation fuel, which can reduce greenhouse gas emissions by up to 80%. The planned composite five-blade reversible propellers will be 10% quieter. In addition, the ME-1A is being designed to have long-term propulsion flexibility so that as renewable propulsion systems mature, the regulatory framework to certify them is adopted and the infrastructure to support them is in

CLOCKWISE FROM ABOVE:

At the end of March, the Seastar made its maiden test flight, a 32-minute sortie from its base in Oberpfaffenhofen, Germany. Flight tests for water operations are scheduled for the summer of 2024
Dornier Seawings

Dornier Seawings is aiming to have EASA certification by 2025, allowing the company to pursue series production
Dornier Seawings

The Seastar cabin is ergonomically designed and will offer generous shoulder and legroom, with either six premium leather seats and a lavatory (optional) or seven premium leather seats without a lavatory
Dornier Seawings

Dornier Seawings Seastar is undergoing flight trials. The composite airframe comprises five types of glass fibres and three carbon fibres, layered carefully with calculated thickness and formation
Dornier Seawings

place, the platform will be capable of transitioning to the systems that best-fit operators' individual mission needs and sustainability goals.

Fresh from its presence at the 2024 Singapore Airshow, Mallard Enterprises has recently announced the signing of the latest Letter of Intent (LOI) for four aircraft with Skylinks Aviation of Goa, India. This brings Mallard Enterprises' cumulative backlog value to US\$250m (£231m).

Dutch designed

Cormorant SEAplanes is developing a practical, adaptable, eight-seat amphibious aircraft focusing on sustainability in the Netherlands.

Powered by two electric motors of 260kW/h (349hp) each, it is powered by a ducted fan situated in the centre of the airframe, using an automated five-blade fan system developed for the RFB [Rhein-Flugzeugbau GmbH] Fan Trainer, a military training aircraft produced in Germany.

Cormorant is designed for a maximum speed of 460km/h (248kts) with a maximum take-off weight of 2,240kg (4,938lb); the cruising speed is lower and varies between 270km/h (145kts) and 350km/h (189kts).

They are designed to be dual energy vector to make the electrical power systems suitable for certification (EASA CS23 Level III). These can be batteries combined with an SAF turbogenerator or liquid hydrogen fuel cells. The aircraft seats seven passengers and a pilot and can be converted to air ambulance or cargo transport in minutes. The certified flight distance is approximately 810km, with a flight endurance of some 3.75 hours.

At the end of November 2023, Cormorant SEAplanes relocated from its Hilversum base to Teuge International Airport, where it moved into the hangar of E-Deck, an initiative of Dutch entrepreneur Evert-Jan Feld. The E-Campus developed there is intended to become the centre of electric flying in the Netherlands.

Cormorant's hopes are being aided by its status as an industry partner in the Scottish Sustainable Aviation Test Environment 2 (SATE 2).

According to Chris Rijff, Cormorant SEAplanes's Managing Director: "For a company such as ours, the



opportunities from participation cannot be over-emphasised. SATE provides an ideal, practical developmental ecosystem with opportunities for working together so that Cormorant can progress towards realisation as a sustainable air transport solution for remoter communities' needs.

"Beyond this short-term project, we are looking to develop our flying proof-of-concept within the favourable development environment provided in Scotland – where significant market potential is apparent for Cormorant."

As part of this project, Cormorant

is working with German companies Leichtwerk AG in Brunswick and Hoffmann Propeller in Rosenheim. The company also works closely with the University of Glasgow and Robert Gordon University in Aberdeen.

A new era beckons

At the time of writing, Dornier Seawings is the furthest along its path to commercialisation. The company had just conducted the first flights on its second prototype (the first flight was carried out on March 22). Flight tests for water operation will follow during the



summer, reveals Alvarez-Munoz, marking milestones toward certification scheduled for next year.

"We are aiming to have the Seastar recertified under CS-23 EASA by 2025," she says. "Although it is already certified under EASA, significant changes have been implemented, requiring a new certification. Achieving this milestone will enable us to launch the Seastar into series production."

For Alvarez-Munoz, the highest potential for luxury tourism operations is expected from the Middle East, India, and Asia. Worldwide solo adventurers are also

showing interest, particularly from the US, Canada, and Europe.

As Seastar and others demonstrate, their respective abilities to operate from existing docks or floating platforms minimises the need for additional infrastructure. Seastar, for example, can operate from the shore-side area of existing docks with a minimal slope or from floating platforms that are very easily installed.

As Eric Lithun, General Manager of the ELFLY Group, proclaimed when signing its agreement of intent with the Lofoten Council: "Seaplanes are coming back!" **AI**

ABOVE: Elfly's NOEMI will be passenger ready by 2030, linking the populations of Norway's fjords and lakes
Elfly Group

TOP: NOEMI has received financial backing from the Norwegian government, bringing production of the nine-seater seaplane closer to reality
Elfly Group



Eight Questions

As managing director of Leonardo Helicopters UK, **Adam Clarke** is focused on ensuring the AW149 is the best choice for the UK's new medium helicopter requirement as well as introducing new innovative technology across the company. Making time in his busy schedule, he spoke to *Air International* about his vision for Leonardo

Question 1: Your role carries significant responsibility and influence, what personal challenges have you encountered and how have you navigated them?

The role of Leonardo Helicopters UK is vitally important to protecting our country, our armed forces, and our civil liberties worldwide. Our aircraft are used domestically and internationally to protect various defence assets and personnel, provide search and rescue operations, deliver urgent humanitarian aid, and keep us and those who need their services safe.

This responsibility weighs heavily upon everything I do and keeps me focused. A sense of urgency is paramount above all, and it can literally be life and death to those operating the aircraft.

Alongside the operational aspects, I absolutely recognise the importance that my role and the business have to the UK defence industrial landscape and that they need continuous focus.

I aim to sustain and grow this business and continue the 100-plus year legacy of leading international aerospace innovation from the Southwest of the UK.

Question 2: Leonardo is proposing the AW149 as the UK's New Medium Helicopter (NMH). Could you elaborate on its unique features and how you have contributed to this innovative pitch?

In addition to the Invitation to Negotiate for the NMH programme, which the UK MOD announced at the end of February, we are putting forward our AW149 helicopter. It's a proven, in-service medium multi-role military helicopter designed this generation for modern battlefield operations.

It was designed to survive. With its military certification in 2014, the multi-role AW149 began life as an all-new, blank sheet of paper military design. It is focused on survivability on the modern battlefield;

operations from austere environments and maximising aircraft availability while minimising through-life costs. Today, the AW149's exacting military off-the-shelf design underpins its selection by multiple international armed forces.

Leonardo has committed that, if selected, the AW149 build will occur in the UK, and the resulting export products will be produced at the Home of British Helicopters in Yeovil and through its nationwide 'Team AW149 UK' supply chain. AW149 work will directly create or sustain a number of highly skilled jobs nationwide and support more than 12,000 helicopter jobs across Leonardo's established supply chain.

Question 3: Can you describe your typical day (if there is such a thing)?

As you would expect, there is not one typical day and that's what makes my role interesting. Leonardo designs, develops, builds, and certifies world-class advanced helicopters, but we are so much more...

We are developing the next generation of flight with new autonomous uncrewed systems. We have design and development engineers who are creating and testing new advanced technologies.

We support and make available our domestic and international aircraft from our cutting-edge support business across multiple sites. We also have advanced manufacturing for Transmissions and Dynamic components for the wider Leonardo helicopter business.

We have an active aerodrome whereby I am the accountable manager. Of course, I have managing director responsibilities for a £1bn P&L [Profit and Loss], selling helicopters internationally with all of the challenges that come with this. It's a fantastic job, with every day being different. Whether that is determining the company's strategic direction or representing the company in the government, front line commands, or the local community. The diversity is fantastic.

CLOCKWISE FROM RIGHT:

Leonardo firmly believes that its AW149 is the ideal solution for the UK's New Medium Helicopter (NMH) requirement

All images via Leonardo

Leonardo will deliver its final AW101 'SAR Queen' to Norway this year. The company's relationship with the RNoAF dates back 50 years, with a key focus on helicopter-based SAR operations.

The AW149 was developed from the outset as a medium-lift multirole helicopter intended for military service; it's a point that Clarke has been keen to make when promoting the type

A Royal Navy Wildcat HMA2 launches a Martlet lightweight multirole missile (LMM) which has a range of 7km, and a 3kg warhead. Each Wildcat is capable of carrying up to 20 Martlet missiles, which is a significant deterrent in maritime operations



Question 4: With the increase in drone use and the development of multiple eVTOL platforms, where do you think helicopters will fit in in the future? Do you see their use declining across the civil or commercial sectors?

It's clear that the marketplace is booming. There are fantastic opportunities for the helicopters we make here in the UK and across the world at one of our many Leonardo sites with our current and emerging global customer base.

Here at Leonardo, we see the significance of traditional helicopters remaining for many decades to come across the civil/commercial and military sectors.

In Yeovil, we pride ourselves on being the Home of British Helicopters. While we have a legacy of building and flying helicopters since 1947, we are very much looking to the future. We have teams exploring cutting-edge technologies in the uncrewed domain and crewed, uncrewed teaming across aircraft.

For example, Leonardo's Future

Programmes Group was established in 2022 as a centre of excellence for emerging rotorcraft technologies, and this innovation hub is already proving to be a game changer for the future of helicopter design and development.

The team's initial focus has been project Proteus, the UK Ministry of Defence's (MOD) Technology Development Programme (TDP), which is investigating the future of military maritime vertical take-off and landing (VTOL) systems. Work is being carried out at a rapid pace to deliver this collaborative project alongside the MOD.

Last year, Leonardo and the MOD unveiled a conceptually mature design: a two-three-ton technology demonstrator based on a single main rotor design. The ambition is for this demonstrator to take flight next year.

So, it's not about helicopters fitting in; it's about broadening the marketplace and recognising the different roles all platforms can play in meeting the variety of operators' mission demands.

Question 5: Automation and autonomy across aircraft platforms have steadily increased in the last decade. What are the benefits and concerns if you feel some are looking towards the future?

We are exploring the art of the possible at a capability level, which also involves extensive adoption of autonomy and automation. This requires us to draw on expertise across Leonardo to develop our solutions, from basic air vehicle operation to systems management. All of this combined recognises the complexities of airborne safety certification, an area in which we excel.

Our particular focus in Somerset is in the uncrewed domain, where Leonardo aims to prove the viability of Uncrewed Air Systems in complex operating environments.

Leonardo will do this using novel approaches to increase mission effectiveness, drive towards fully autonomous operations, adopt highly modular concepts and drive down the cost of ownership.

Question 6: *The iAero Innovation Centre is highly regarded as a hub for cultivating innovative opportunities. What significant contributions has it made to the aerospace community, and how does Leonardo work with the centre?*

iAero is a £10 million, purpose-built research, design and innovation facility that opened in 2022 and is now delivered through a collaboration between Somerset Council and Leonardo. It is designed to support the competitiveness and growth of the local aerospace, advanced engineering, and manufacturing sector.

Leonardo is intrinsically integrated into a network of innovative opportunities across multiple countries and locations. iAero provides the perfect opportunity to develop the local innovation ecosystem through collaboration with industry, academia, institutions, and local government in an environment more suited to the need.

Based at the centre, Leonardo's Technology and Innovation team has developed a series of technology pillars to support the future of rotary-wing capability in the UK. These focus on productivity, connected systems, autonomy, and future VTOL technologies. The ability to operate in such a collaborative environment offers significant benefits over a more traditional approach.

The centre has championed an introduction of Factory of the Future equipment for collaborative use within the aerospace sector, including an Additive Layer development cell. These digital technologies include Co-Bot, VR/AR cell, SMART bench, CAD systems and software, among other tracking and system management systems. This benefits not only Leonardo but also its supply chain, other iAero tenants, and companies wishing to buy membership at the centre.

The centre also sits at the heart of



Leonardo's community engagement through various events, workshops, and networking opportunities. Issues such as sustainable aviation and net zero, social value, STEM and accelerated learning, inclusion and diversity, and environmental issues remain key to our business and social value policy.

Question 7: *Rotorcraft technology is changing, particularly in the next-generation military assault transport sector, with tiltrotors becoming popular, particularly with the US services. What are your views on this and is Leonardo looking at military tiltrotors?*

The military and civil markets are cyclical and Leonardo is committed to advancing technology positions in the evolving aerospace landscape.

The United Kingdom and the Netherlands have agreements with the US Army as part of the US Future Vertical Lift Program, including the Future Long Range Assault Aircraft (FLRAA).

Leonardo is in the latter stages of achieving the world's first certification for a tiltrotor with the AW609 and is developing a demonstrator for a next-generation civilian tiltrotor as part of the European Union's Clean Sky 2 programme.

Our CEO, Roberto Cingolani, recently commented at the company's Industrial Plan 2024-28 launch event that notable platforms, such as tiltrotor and rotorcraft systems, play a pivotal role in the aerospace domain. Leonardo aims to explore this through international co-operation, as a recent MOU [memorandum of understanding] with Bell indicates.

This MOU evaluates co-operation opportunities in the tiltrotor technology domain.

Leonardo has always firmly endorsed tiltrotor technologies to meet evolving rotorcraft requirements, even more so as new needs emerge in the market. So, it's an exciting time to examine this market; more to come soon.

Question 8: *Away from aviation, how do you spend your free time? Do you have any hobbies?*

As you can imagine, I enjoy spending as much quality time with my family as possible in a demanding role where I am away from home for long periods.

We enjoy long walks with our 45kg four-year-old Bernedoodle dog and, whenever possible, look forward to relaxing holidays somewhere warm on a beach with a good book. Finding those moments to switch off and recharge is so important! **AI**



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eVTOL

What are the latest developments in the emerging eVTOL market segment? Will the reality match the hype?

Starliner

NASA astronauts will fly Starliner and a United Launch Alliance Atlas V rocket in a crewed mission to the International Space Station

Eight Questions

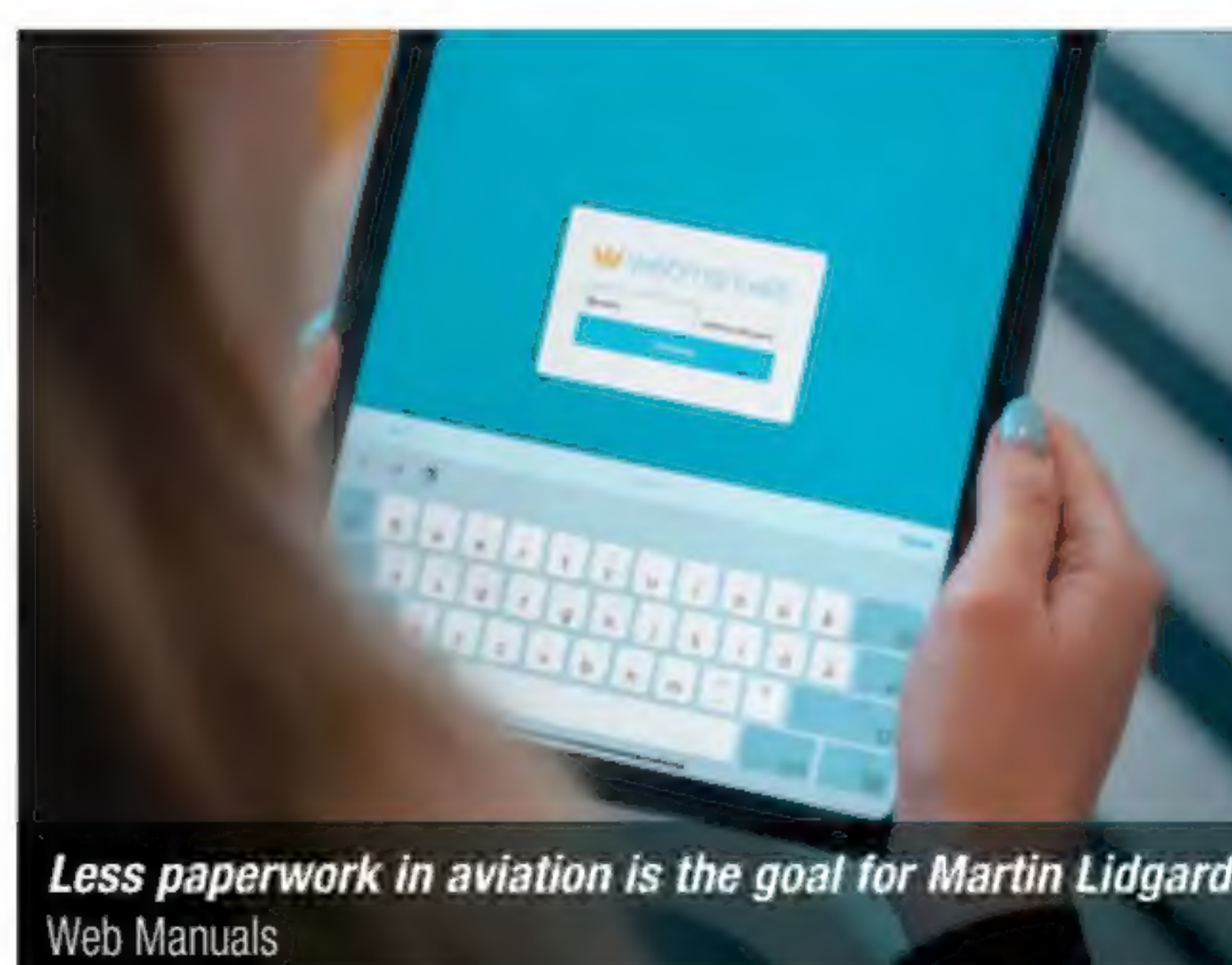
Martin Lidgard, CEO of Web Manuals, spoke to *Air International* on what this has brought to the aviation industry

Mediation in aviation

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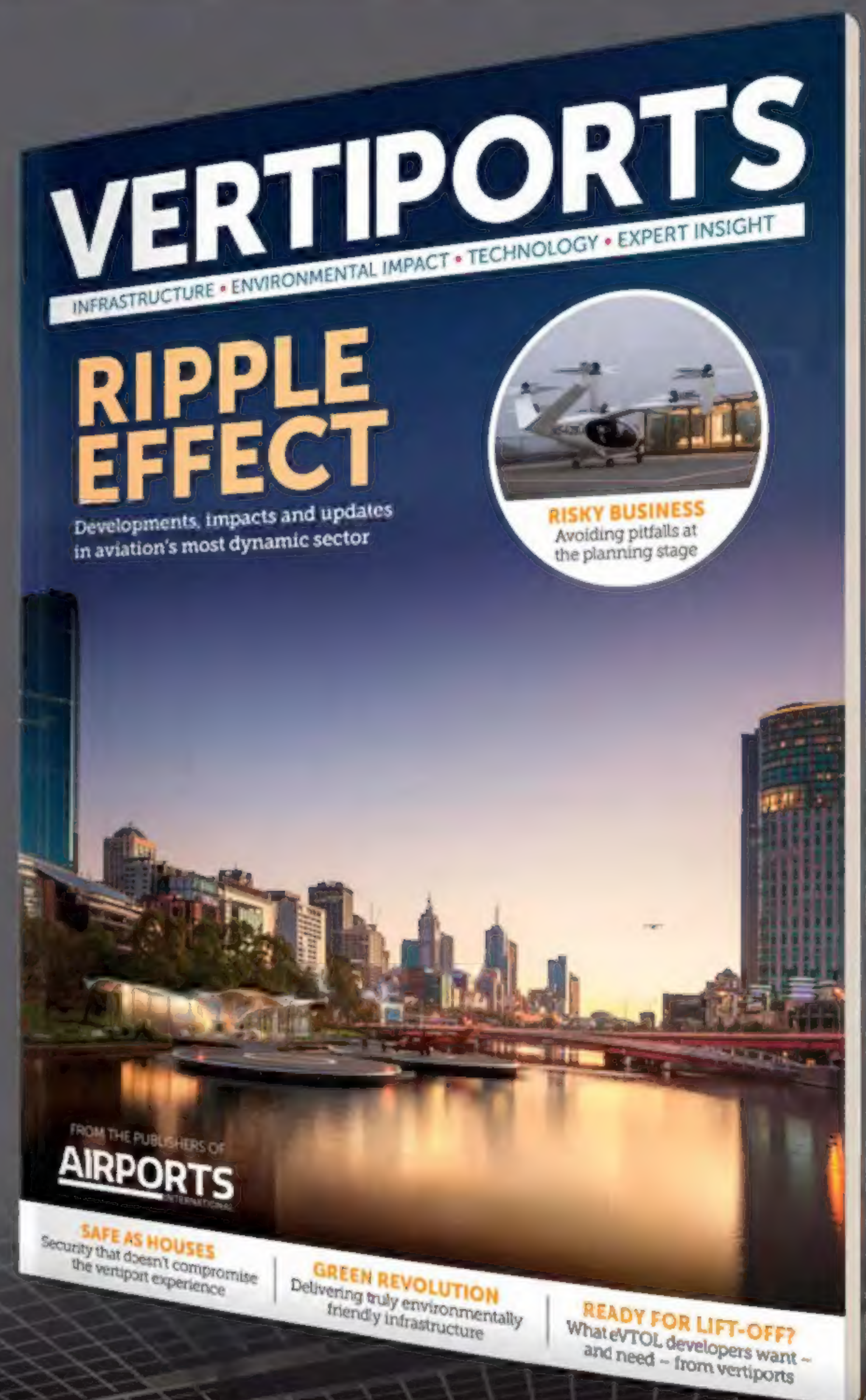
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These are exciting times for aviation, not least in the field of advanced air mobility (AAM) and vertiports. Our latest *Vertiports* issue looks at everything from how to tackle risk at the planning stage to how to foster positive engagement with those living and working near potential vertiport sites. It includes insight from some of the biggest names in the business, not least the eVTOL developers, who spoke exclusively to us about their vertiport needs and expectations. From charging to security, if you're a vertiports stakeholder – or want to be – you can find everything you need to know within these pages.

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